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PROPAGATION AND DISTRIBUTION OF FOOD FISHES

FISCAL YEAR 1924

Clemson University
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LEN C. LEACH

DEPARTMENT OF COMMERCE
Bureau of Fisheries Document No. 978

DEPARTMENT OF COMMERCE
BUREAU OF FISHERIES
HENRY O'MALLEY, Commissioner

PROPAGATION AND DISTRIBUTION OF FOOD FISHES

FISCAL YEAR 1924

By GLEN C. LEACH
Assistant in Charge, Division of Fish Culture

APPENDIX V TO THE REPORT OF THE U. S. COMMISSIONER
OF FISHERIES FOR 1924

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PROPAGATION AND DISTRIBUTION OF FOOD FISHES, FISCAL YEAR 1924[1]

By GLEN C. LEACH, *Assistant in Charge, Division of Fish Culture*

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INTRODUCTION

During the fiscal year 1924 the fish-cultural activities of the bureau were not varied in any essential particular from those of recent years. No extension of the fields of operation was possible owing to lack of funds. However, the output of fish and fish eggs was the largest in many years, notwithstanding the fact that the funds available for the work were no greater than in 1917. There is no question but that at the present time the fish-cultural stations of the bureau are operating on a very high standard of efficiency, and the results are being accomplished in the face of increased expenditures for all materials and labor entering into the work.

FRESH-WATER FISHES

The demands for fish for stocking interior waters were greatly increased in 1924, probably because the interest in fish culture is becoming greater and because of the constantly increasing number of fishponds constructed. Some of the States have recently established additional hatcheries, opened up new fields of operation, and strengthened their game-warden service.

With respect to the fishes of interior waters no material changes occurred in the bureau's methods of procedure. No extensions in hatching facilities were made during the year, since the financial situation prohibits the enlargement of the pond areas. Moreover, the holding of a larger stock of brood fish would have involved increased expenditures for food, and funds to cover its purchase were out of the question.

The bureau has always depended upon the overflowed lands along the Mississippi River to furnish approximately 70 per cent of the black bass, crappie, and other so-called warm-water fishes needed for stocking ponds and streams in various parts of the country, the facilities for the production of such species at the permanently established pond-culture stations being too limited to meet the requirements.

In view of the uncertain conditions involved in the rescue work, it is realized that dependence upon the Mississippi River collections for fish of this character can not be continued indefinitely. During some seasons the floods do not attain their usual volume. In such years they cover only a comparatively small area, and there is a consequent shortage in the supply of fish. This naturally necessitates delay in the filling of many applications, and they have to be carried on file for attention the following year. The difficulties encountered will probably compel the bureau to take steps in the near future for the establishment of bass stations on a widely extended scale. For this purpose it may be possible to obtain control of certain areas that are not suitable for agriculture and devote from 100 to 1,000 acres of such lands to the cultivation of bass and kindred species. It is believed that ponds of this size could be established in several sections of the country, and that through such means it would be possible to meet the demands for warm-water pondfishes for some years to come. Trout are being produced in sufficient numbers to meet all present demands.

Fish-cultural work in the Great Lakes regions was limited to the collection and incubation of eggs of the whitefish, lake trout, and pike perch, and the distribution of the resulting fry on suitable spawning areas. As usual the eggs were taken by placing men on the fishing boats to remove the eggs before the fish were sent to market.

MARINE AND ANADROMOUS FISHES

While there has been no expansion of the fields covering this branch of the bureau's work, fluctuations occur from year to year, depending upon weather conditions. The usual number of salmon stations was operated on the Pacific coast. It has been the policy to enlarge the rearing facilities at such stations as much as possible, so as to permit of a yearly increase in the number of fingerling salmon distributed. Some minor improvements were effected in hatching equipment in the interest of greater efficiency.

The eggs of the salmon were obtained by the usual method of placing racks across the streams to intercept the run. Eggs of the cod and other marine species were secured by placing spawn takers on the boats, except in the case of the Woods Hole station, which is equipped with a cod pool where spawning fish are held and permitted to deposit their eggs under more or less natural conditions. On receipt of a report during the spring of 1924 that large numbers of cod with ripe eggs were being taken off the fishing banks, the bureau at once placed spawn takers on the boats operating in this region to take and fertilize the eggs and immediately plant them on the natural spawning grounds. All eggs thus taken represent actual saving, since otherwise they would be lost in the process employed in preparing the fish for market. It would doubtless be expedient for some of the States to undertake similar operations for the salvage of eggs of the shad, herring, and other commercial fishes. The work could be conducted at points where it is impossible to transfer the eggs to hatcheries for incubation, or where fishing operations are prosecuted on too small a scale to warrant the establishment of hatcheries.

COOPERATIVE OPERATIONS WITH STATES, OTHER FEDERAL AGENCIES, AND FOREIGN GOVERNMENTS

It has been the bureau's policy to cooperate with the States in fish-cultural activities wherever it could be advantageously managed, and such work has been of material benefit both to the States and to the bureau. It is largely through cooperation that the bureau was able to increase its output in 1924 over that of recent years, notwithstanding the curb placed upon its efforts by the limited funds available. Exchanges of eggs with State fishery authorities were made on an extended scale, and in so far as was practicable distributions of fish were planned with the view of avoiding duplication of effort in making deliveries. In many instances applicants apply to their State authorities and also to the bureau for fish. They are frequently inconsistent in such demands, requesting a certain species from the State and another wholly imcompatible species from the bureau, both of them being intended for the same waters. In several instances the bureau has aided State authorities by detailing men of experience to assist in the establishment of fish-cultural stations or to give advice in regard to pending fish-cultural problems.

Cooperative work along similar lines has been taken up with the Forest Service, the Reclamation Service, and the National Park Service. All of these agencies have been of great assistance to the bureau in the transportation of fish and eggs to waters within the jurisdiction of the Government. At this time practically all of the national preserves are well protected and fishing is closely regulated.

It is the general opinion that the stocking of waters located within the national reservations is of considerable benefit to surrounding communities. These waters serve as nurseries to the fish planted therein, and after attaining the adult stage the fish usually seek the lower waters of the streams or such portions as contain a more abundant food supply. In this way the stocking of waters outside the reservations is brought about.

Very satisfactory exchanges were effected with the Canadian Government during the year. The bureau's Craig Brook (Me.) station was stocked with Atlantic salmon eggs furnished from Canadian hatcheries, and the bureau furnished in return eggs of other especially desired species.

FISH CONSERVATION

The bureau finds a growing sentiment in favor of fish protection. This is evidenced through the recent changes in the fishery laws of many States, the more favorable legislation enacted being made possible largely through the influence and united efforts of interested organizations and individuals.

It is realized that if the streams are depleted there will be no means of obtaining fish or fish eggs for propagation, and for a long time the bureau has been urging the protection of fish during the spawning season, a reduction in the bag limit, and an increase in the size limit.

If the supply of fish in public streams is to be maintained it is very essential that special consideration be given to these three important points.

There has been considerable agitation in regard to the establishment of dams in rivers. Where such obstructions prevent the passage of the anadromous species to their natural spawning grounds they may constitute a serious menace to the future of certain fisheries. Under some conditions dams are a distinct benefit, since they form large reservoirs that furnish more protection and longer nursery areas to fish than do the natural streams, and thus serve as a source for the development of a large amount of natural food for fish.

Every year the bureau is receiving an increased amount of cooperation from fish and game clubs in the protection of waters in which they are directly interested. Such organizations not only receive the fish and carefully plant them in suitable places, but they are instrumental in the enforcement of the bag and size limit and in the protection of local waters against illegal fishing.

A more favorable sentiment is developing along the upper Mississippi River with regard to the salvage of food fishes from landlocked pools, and several organizations have furnished within recent years an appreciable amount of assistance in the work. This is especially true in Louisiana, where the fish are removed from more or less inaccessible waters and placed in streams and lakes where they will be of future benefit to the public.

Part 1.—FISH PRODUCTION: PROPAGATION AND RESCUE WORK

TABULAR SUMMARIES OF OPERATIONS

SPECIES OF FISHES HANDLED

During the fiscal year 1924 the fish-cultural work of the bureau, including artificial propagation and rescue work, involved the handling of 53 species of fishes, as follows:

LIST OF SPECIES HANDLED

The catfishes (Siluridæ):
  Blue catfish (*Ictalurus furcatus*).
  Channel catfish (*Ictalurus punctatus*).
  Horned pout, bullhead (*Ameiurus nebulosus*).
  Mississippi catfish (*Ameiurus lacustris*).
  Yellow catfish (*Ameiurus natalis*).
  Black bullhead (*Ameiurus melas*).
  Mud catfish (*Leptops olivaris*).
The suckers (Catostomidæ):
  Mongrel buffalo fish (*Ictiobus urus*).
  Common buffalo fish (*Ictiobus cyprinella*).
  Small-mouth buffalo fish (*Ictiobus bubalus*).
The carps (Cyprinidæ): German carp (*Cyprinus carpio*).
The shads and herrings (Clupeidæ):
  Shad (*Alosa sapidissima*).
  Glut herring (*Pomolobus æstivalis*)

THE SALMONS, TROUTS, WHITEFISHES, ETC. (SALMONIDÆ):
- Common whitefishes, (*Coregonus albus* and *C. clupeaformis*).
- Cisco (*Argyrosomus artedi*).
- Chinook salmon, king salmon, quinnat salmon (*Oncorhynchus tschawytscha*).
- Chum salmon, dog salmon, (*Oncorhynchus keta*).
- Humpback salmon, pink salmon (*Oncorhynchus gorbuscha*).
- Silver salmon, coho salmon (*Oncorhynchus kisutch*).
- Sockeye salmon, blueback salmon, redfish (*Oncorhynchus nerka*).
- Steelhead salmon (*Salmo gairdneri*).
- Atlantic salmon (*Salmo salar*).
- Landlocked salmon (*Salmo sebago*).
- Rainbow trout (*Salmo shasta*).
- Black-spotted trout, redthroat trout (*Salmo lewisi*).
- Loch Leven trout (*Salmo levenensis*).
- Lake trout, Mackinaw trout (*Cristivomer namaycush*).
- Brook trout (*Salvelinus fontinalis*).

THE GRAYLINGS (THYMALLIDÆ): Montana grayling (*Thymallus montanus*).

THE SMELTS (OSMERIDÆ): Smelt (*Osmerus mordax*).

THE PIKES (ESOCIDÆ):
- Little pickerel (*Esox vermiculatus*).
- Common pickerel (*Esox lucius*).

THE SUNFISHES, BLACK BASSES, AND CRAPPIES (*Centrarchidæ*):
- Crappies (*Pomoxis annularis* and *P. sparoides*).
- Large-mouth black bass (*Micropterus salmoides*).
- Small-mouth black bass (*Micropterus dolomieu*).
- Rock bass (*Ambloplites rupestris*).
- Warmouth bass, goggle-eye (*Chænobryttus gulosus*).
- Green sunfish (*Apomotis cyanellus*).
- Red-breasted bream (*Lepomis auritus*).
- Bluegill sunfish (*Lepomis pallidus*).
- Long-eared sunfish (*Lepomis megalotis*).
- Common sunfish (*Eupomotis gibbosus*).

THE PERCHES (PERCIDÆ):
- Pike perch (*Stizostedion vitreum*).
- Sauger (*Stizostedion canadense*).
- Yellow perch, ringed perch (*Perca flavescens*).

THE SEA BASSES (SERRANIDÆ): White bass (*Roccus chrysops*).

THE DRUMS (SCIÆNIDÆ): Fresh-water drum, lake sheepshead (*Aplodinotus grunniens*).

THE CODS (GADIDÆ):
- Cod (*Gadus callarias*).
- Haddock (*Melanogrammus æglefinus*).
- Pollock (*Pollachius virens*).

THE FLOUNDERS (PLEURONECTIDÆ): Winter flounder, American flatfish (*Pseudopleuronectes americanus*).

OUTPUT

The combined work of the fish-cultural and the rescue stations of the bureau during the fiscal year 1924 resulted in a gross output of 5,361,947,981 eggs, fry, and fingerling fish. Losses in transportation amounted to 137,327, leaving a net total of 5,361,810,654 fish and eggs actually distributed, an increase of 1,046,951,625 over the net output of the preceding year. About 90 per cent of the output consisted of such commercial species as the salmons, whitefishes, cisco, pike perch, yellow perch, shad, herring, cod, haddock, pollock, and flounder. With the exception of a few shipments furnished to State fish commissions, the entire output of the commercial species was returned to the waters from which the egg collections were made.

Summary, by species, of the output of fish and fish eggs during the fiscal year ended June 30, 1924

Species	Eggs	Fry	Fingerlings	Total
Catfish			30, 245, 755	30, 245, 755
Buffalofish	281, 728, 500		23, 706, 323	305, 434, 823
Carp	13, 500, 000	28, 875, 000	36, 693, 618	79, 068, 618
Shad		15, 033, 000		15, 033, 000
Glut herring		95, 000, 000		95, 000, 000
Whitefish	73, 560, 000	299, 220, 000		372, 780, 000
Cisco	10, 000, 000	128, 360, 000		138, 360, 000
Chinook salmon	12, 785, 100	1, 801, 000	41, 526, 405	56, 112, 505
Chum salmon		23, 512, 320	765, 600	24, 277, 920
Silver salmon		11, 419, 990	11, 430, 150	22, 850, 140
Sockeye salmon	3, 320, 000	8, 819, 840	30, 168, 545	42, 308, 385
Humpback salmon		1, 260, 000	11, 580	1, 271, 580
Steelhead salmon	2, 180, 000	383, 685	4, 927, 290	7, 490, 975
Atlantic salmon		494, 000	7, 000	501, 000
Landlocked salmon	90, 500	752, 350	155, 360	998, 210
Rainbow trout	1, 360, 611	1, 261, 000	3, 075, 513	5, 697, 124
Black-spotted trout	13, 332, 000	6, 314, 900	2, 710, 000	22, 356, 900
Loch Leven trout	2, 178, 000		2, 095, 800	4, 273, 800
Lake trout	1, 839, 646	34, 286, 710	313, 296	36, 439, 652
Brook trout	17, 857	3, 052, 089	9, 569, 385	12, 639, 331
Smelt	8, 000, 000	9, 300, 000		17, 300, 000
Pike and pickerel		7, 392, 000	784, 027	8, 176, 027
Crappie			22, 575, 531	22, 575, 531
Large-mouth black bass		710, 950	1, 675, 724	2, 386, 674
Small-mouth black bass		596, 300	69, 500	665, 800
Rock bass			100, 800	100, 800
Warmouth bass			4, 519	4, 519
Sunfish			27, 552, 589	27, 552, 589
Pike perch	97, 005, 000	71, 250, 000		168, 255, 000
Yellow perch		212, 009, 400	630, 452	212, 639, 852
White bass			714, 447	714, 447
Fresh-water drum			230, 566	230, 566
Cod	481, 355, 000	392, 423, 000		873, 778, 000
Haddock	235, 330, 000	2, 590, 000		237, 920, 000
Pollock		263, 440, 000		263, 440, 000
Winter flounder		2, 244, 290, 000		2, 244, 290, 000
Miscellaneous fishes			8, 641, 131	8, 641, 131
Total	1, 237, 582, 214	3, 863, 847, 534	260, 380, 906	5, 361, 810, 654

Assignments of fish eggs to State and Territorial fish commissions, fiscal year 1924

State and species	Number
California:	
Black-spotted trout	100, 000
Lake trout	75, 000
Colorado: Steelhead salmon	75, 000
Connecticut:	
Lake trout	50, 000
Pike perch	5, 180, 000
Hawaii: Steelhead salmon	25, 000
Idaho: Chinook salmon	140, 000
Illinois:	
Brook trout	2, 500
Chinook salmon	10, 000
Loch Leven trout	20, 000
Rainbow trout	55, 000
Whitefish	6, 560, 000
Iowa:	
Brook trout	9, 000
Rainbow trout	152, 220
Pike perch	13, 825, 000
Maine: Lake trout	75, 000
Maryland: Rainbow trout	36, 666
Massachusetts: Lake trout	3, 000
Michigan:	
Cisco	10, 000, 000
Whitefish	3, 000, 000
Minnesota: Lake trout	250, 000
Missouri: Rainbow trout	11, 000
Montana:	
Black-spotted trout	3, 872, 000
Chinook salmon	200, 000
Loch Leven trout	1, 500, 000
Nebraska: Rainbow trout	148, 000
Nevada: Steelhead salmon	25, 000
New Hampshire: Lake trout	75, 000
New Mexico: Steelhead salmon	25, 000
New York:	
Black-spotted trout	10, 000
Lake trout	320, 000
Rainbow trout	10, 000
Steelhead salmon	100, 000
North Dakota: Steelhead salmon	50, 000
Oregon:	
Black-spotted trout	1, 000, 000
Chinook salmon	10, 886, 000
Rainbow trout	323, 010
Sockeye salmon	3, 120, 000
Pennsylvania:	
Landlocked salmon	20, 000
Loch Leven trout	108, 000
Pike perch	78, 000, 000
Whitefish	16, 680, 000
South Dakota: Loch Leven trout	250, 000
Utah:	
Lake trout	250, 000
Landlocked salmon	20, 000
Steelhead salmon	100, 000
Vermont;	
Lake trout	291, 646
Landlocked salmon	20, 000
Steelhead salmon	75, 000
Wisconsin: Lake trout	450, 000
Wyoming:	
Black-spotted trout	723, 000
Loch Leven trout	100, 000
Total	158, 406, 042

Shipments of fish eggs to foreign countries, fiscal year 1924

Country and species	Number
Canada: Black-spotted trout	250, 000
Chile: Sockeye salmon	200, 000
Czechoslovakia: Steelhead salmon	50, 000
France:	
Black-spotted trout	50, 000
Rainbow trout	50, 000
Netherlands: Chinook salmon	200, 000
Poland: Rainbow trout	50, 000
Total	850, 000

EGG COLLECTIONS

The records show a large increase in egg collections over those of the preceding year. This excess was made possible by the unusual degree of success attained in the work with the commercial fishes, the collections of the marine species alone exceeding those in 1923 by over 800,000,000. An important factor in this connection was the work conducted in connection with the fisheries on Georges Bank, these operations yielding nearly 197,000,000 eggs in addition to those obtained for the hatcheries. In its prosecution spawn takers detailed by the bureau accompany the vessels to these distant fisheries to take and fertilize eggs of the cod and haddock, which would otherwise be discarded, and plant them on the natural spawning areas.

Other notable increases in the yearly collections were in those of the pike perch, yellow perch, and black-spotted trout in the Yellowstone National Park, and of Loch Leven trout in the Meadow Creek field.

Comparison of egg collections, fiscal years 1924 and 1923

Species	1924	1923
Buffalofish	376, 778, 500	179, 173, 600
Carp	55, 325, 000	160, 500, 000
Shad	16, 452, 000	17, 877, 000
Glut herring	222, 740, 000	313, 422, 620
Whitefish	481, 018, 000	537, 546, 000
Cisco	200, 790, 000	76, 800. 000
Pilotfish		255, 000
Chinook salmon	55, 474, 800	30, 889. 000
Chum salmon	25, 344, 700	26, 513, 500
Humpback salmon	1, 573, 000	1, 099, 200
Silver salmon	22, 722, 400	15, 159, 800
Sockeye salmon	46, 688, 000	97, 886, 000
Steelhead salmon	6, 031, 164	7, 946, 300
Landlocked salmon	1, 298, 600	852, 350
Rainbow trout	11, 433, 217	11, 488, 410
Black-spotted trout	39, 859, 500	16, 655, 820
Loch Leven trout	7, 920, 050	98, 130
Lake trout	78, 016, 233	77, 775, 890
Brook trout	18, 488, 304	19, 109, 040
Smelt	18, 000, 000	42, 000, 000
Pike perch	333, 875. 000	230, 040, 000
Sauger	8, 400. 000	
Yellow perch	224, 780, 000	151, 010, 000
Striped bass		22, 084, 000
Cod	1, 002, 814. 000	1, 279, 709, 000
Haddock	239, 610, 000	109, 220, 000
Pollock	401, 824, 000	420, 536, 000
Winter flounder	2, 404, 887, 000	1, 391, 411, 000
Total	6, 302, 143, 468	5, 237, 057, 660

FISH-RESCUE WORK

That part of the 1924 output of fish obtained through the rescue of stranded fishes in the Mississippi Valley region was increased over that of 1923 by upward of 10,500,000. The following table gives a résumé of operations:

Number and disposition of fish rescued, fiscal year 1924

Station and species	Delivered to applicants	Restored to original waters	Total
Homer, Minn.:			
Black bass	89, 635	65, 310	154, 945
Buffalo fish		242, 795	242, 795
Carp	125	3, 755, 770	3, 755, 895
Catfish	68, 245	2, 370, 230	2, 438, 475
Crappie	58, 865	8, 464, 010	8, 522, 875
Drum		67, 020	67, 020
Pike and pickerel		230, 000	230, 000
Sunfish	164, 330	9, 093, 320	9, 257, 650
White bass		18, 915	18, 915
Yellow perch	12, 691	324, 889	337, 580
Miscellaneous		206, 835	206, 835
Total	393, 891	24, 839, 094	25, 232, 985
Bellevue, Iowa:			
Black bass	29, 405	7, 750	37, 155
Buffalo fish		13, 885, 150	13, 885, 150
Carp	600	16, 500, 000	16, 500, 600
Catfish	32, 600	3, 750, 000	3, 782, 600
Crappie	445	311, 790	312, 235
Drum		21	21
Pike and pickerel		402	402
Sunfish	27, 385	551, 715	579, 100
White bass		437	437
Yellow perch	2, 755	921	3, 676
Miscellaneous		5, 076, 390	5, 076, 390
Total	93, 190	40, 084, 576	40, 177, 766
La Crosse, Wis.:			
Black bass	96, 070	52, 435	148, 505
Buffalo fish		7, 926, 514	7, 926, 514
Carp	200	12, 270, 570	12, 270, 770
Catfish	95, 900	14, 488, 220	14, 584, 120
Crappie	16, 875	7, 922, 180	7, 939, 055
Drum		161, 370	161, 370
Pike and pickerel		375, 025	375, 025
Sunfish	129, 057	10, 642, 854	10, 771, 911
Warmouth bass	15		15
White bass		2, 174	2, 174
Yellow perch	5, 191	231, 510	236, 701
Miscellaneous		2, 617, 506	2, 617, 506
Total	343, 308	56, 690, 358	57, 033, 666
Marquette, Iowa:			
Black bass	74, 360	20, 745	95. 105
Buffalo fish		1, 284, 800	1, 284, 800
Carp		3, 864, 050	3, 864, 050
Catfish	22, 260	8, 341, 800	8, 364, 060
Crappie		5, 090, 500	5, 090, 500
Drum		2, 000	2, 000
Pike and pickerel		177, 750	177, 750
Sunfish	270	4, 198, 025	4, 198, 295
White bass		691, 600	691, 600
Yellow perch	1, 895	49, 330	51, 225
Total	98, 785	23, 720, 600	23, 819, 385
Rock Island, Ill.:			
Black bass		2, 015	2, 015
Buffalo fish		125, 570	125, 570
Carp		161, 010	161, 010
Catfish		356, 850	356, 850
Crappie		380, 800	380, 800
Drum		155	155
Sunfish		693, 600	693, 600
White bass		155	155
Miscellaneous		502, 400	502, 400
Total		2, 222, 555	2, 222, 555

Number and disposition of fish rescued, fiscal year 1924—Continued

Station and species	Delivered to applicants	Restored to original waters	Total
Atchafalaya, La.:	950	1,650	2,600
Black bass		72,900	72,900
Buffalo fish	600	232,400	233,000
Catfish		30,800	30,800
Crappie		850	850
Pike and pickerel	1,880	54,100	55,980
Sunfish		950	950
White bass		1,100	1,100
Yellow perch		238,000	238,000
Miscellaneous			
Total	3,430	632,750	636,180
Friar Point, Miss.:	33,170	2,435	35,605
Black bass	7,650	36,020	43,670
Catfish	11,890	15,250	27,140
Crappie	5,700	8,450	14,150
Rock bass	67,950	613,800	681,750
Sunfish			
Total	126,360	675,955	802,315
Fairport, Iowa:	289	18,599	18,888
Black bass	12,064	78,265	90,329
Buffalo fish		70,684	70,684
Carp	111	193,046	193,157
Catfish		100,434	100,434
Crappie	23,593	87,257	110,850
Sunfish	538		538
Warmouth bass		108	108
White bass			
Total	36,595	548,393	584,988
Total of all stations:			
Black bass	323,879	170,939	494,818
Buffalo fish	12,064	23,615,994	23,628,058
Carp	925	36,622,084	36,623,009
Catfish	227,366	29,768,566	29,995,932
Crappie	88,075	22,315,764	22,403,839
Drum		230,566	230,566
Rock bass	5,700	8,450	14,150
Pike and pickerel		784,027	784,027
Sunfish	414,465	25,934,671	26,349,136
Warmouth bass	553		553
White bass		714.339	714,339
Yellow perch	22,532	607,750	630,282
Miscellaneous		8,641,131	8,641,131
Grand total	1,095,559	149,414,281	150,509,840

STATIONS AND SUBSTATIONS AND OUTPUT OF EACH

During the fiscal year 1924 propagation work was conducted at 35 main stations and 40 substations. In the following table each main station is listed in its alphabetical order, together with the substations attached thereto. The numbers of fish and eggs furnished for distribution are also shown, including those propagated and those rescued from overflowed lands.

Stations and substations operated and output of each, fiscal year 1924

[Asterisk (*) denotes transfer of eggs. See table, p. 376]

Stations and substations	Species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
Baird, Calif	Chinook salmon			1,242,300	1,242,300
Battle Creek, Calif	do			2,523,700	2,523,700
Mill Creek, Calif	do	(*)	1,050,000	720,000	1,770,000
Baker Lake, Wash	do		38,000		38,000
	Silver salmon	(*)	1,850,000		1,850,000
	Sockeye salmon	(*)	7,517,000	638,000	8,155,000
Birdsview, Wash	Chinook salmon			1,137,105	1,137,105
	Silver salmon	(*)	5,653,000	87,000	5,740,000
	Sockeye salmon	200,000			200,000
	Steelhead salmon	*70,000		555,000	625,000
Duckabush, Wash	Chum salmon		14,540,000		14,540,000
	Humpback salmon		890,100		890,100
	Silver salmon			2,622,000	2,622,000
	Steelhead salmon			209,110	209,110
Quilcene, Wash	Chum salmon		8,972,320		8,972,320
	Silver salmon		1,100,000	1,138,000	2,238,000
	Steelhead salmon			658,450	658,450
Sultan, Wash	Chinook salmon		259,000	278,000	537,000
	Humpback salmon		27,900		27,900
	Silver salmon		1,822,000	45,000	1,867,000
	Sockeye salmon		2,840		2,840
	Steelhead salmon			216,000	216,000
Berkshire trout hatchery, Mass.	Brook trout			107,340	107,340
	Rainbow trout			3,270	3,270
Boothbay Harbor, Me	Winter flounder		1,548,771,000		1,548,771,000
Bozeman, Mont	Black-spotted trout		145,000	651,500	796,500
	Brook trout			792,145	792,145
	Lake trout			61,000	61,000
	Loch Leven trout	*2,078,000		421,000	2,499,000
	Rainbow trout	*40,000		194,000	234,000
	Steelhead salmon			26,000	26,000
Glacier Park, Mont	Black-spotted trout	329,000		665,000	994,000
	Rainbow trout			150,000	150,000
Meadow Creek, Mont	Black-spotted trout		5,400		5,400
	Rainbow trout	*397,215	1,172,122		1,569,337
Cape Vincent, N. Y.	Brook trout		922,000		922,000
	Cisco	*10,000,000	128,360,000		138,360,000
	Lake trout	*13,000	725,000		738,000
	Rainbow trout		89,000		89,000
	Whitefish		72,670,000		72,670,000
	Yellow perch			100	100
Swanton, Vt	Pike perch	*83,180,000	29,800,000		112,980,000
	Yellow perch		10,300,000		10,300,000
Central Station, Washington, D. C.	Chinook salmon		6,000		6,000
	Brook trout			136,600	136,600
	Rainbow trout			23,200	23,200
Bryans Point, Md	Shad		7,963,000		7,963,000
	Yellow perch		193,769,400	150	193,769,550
Lakeland, Md	Large-mouth black bass.			58,585	58,585
	Catfish			2,945	2,945
	Crappie			34,235	34,235
	Sunfish			33,785	33,785
Clackamas, Oreg	Brook trout			542,000	542,000
	Chinook salmon	*4,010,000		7,918,700	11,928,700
	Chum salmon			7,600	7,650
	Silver salmon			8,850	8,800
	Steelhead salmon	25,000		55,600	80,600
Applegate, Oreg	Silver salmon			5,341,800	5,341,800
	Steelhead salmon	*2,085,000		1,721,800	3,806,800
Big White Salmon, Wash.	Brook trout		477,930		477,930
	Chinook salmon			8,487,600	8,487,600
	Rainbow trout			203,000	203,000
	Silver salmon		994,990		994,990
	Steelhead salmon		298,685		298,685
Little White Salmon, Wash.	Chinook salmon	*2,246,000		11,394,000	13,640,000
	Chum salmon			758,000	758,000
Pahsimeroi, Idaho	Chinook salmon		448,000		448,000
Rogue River, Oreg	Black-spotted trout			18,000	18,000
	Chinook salmon			3,647,000	3,647,000
	Silver salmon			2,074,500	2,074,500
	Sockeye salmon			23,700	23,700
	Steelhead salmon			373,500	373,500
Sandy River, Oreg	Chinook salmon			901,000	601,000
	Silver salmon			113,000	113,000
	Steelhead salmon			721,000	721,000

Stations and substations operated and output of each, fiscal year 1924—Continued

Stations and substations	Species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
Clackamas, Oreg.—Con.					
Snake River, Oreg.	Chinook salmon	5,180,000		3,577,000	8,757,000
	Rainbow trout			200,000	200,000
Upper Clackamas, Oreg.	Chinook salmon	*1,349,100			1,349,100
Cold Springs, Ga.	Large-mouth black bass.		37,750	103,750	141,500
	Catfish			5,300	5,300
	Crappie			950	950
	Sunfish			95,600	95,600
Craig Brook, Me.	Atlantic salmon		494,000	7,000	501,000
	Brook trout	(*)	238,000	722,700	960,700
	Humpback salmon		342,000	11,580	353,580
	Landlocked salmon	*90,500	70,000	111,600	272,100
Green Lake, Me.	Brook trout		48,000		48,000
	Landlocked salmon	(*)	667,350		667,350
	Smelt	8,000,000	9,300,000		17,300,000
Duluth, Minn.	Brook trout			136,000	136,000
	Lake trout	825,000	11,830,000	152,000	12,807,000
	Pike perch		1,450,000		1,450,000
	Steelhead salmon			41,000	41,000
	Whitefish		13,000,000		13,000,000
Erwin, Tenn.	Large-mouth black bass.		7,000	25,000	32,000
	Brook trout			247,000	247,000
	Loch Leven trout			36,500	36,500
	Rainbow trout			364,400	364,400
	Rock bass			16,900	16,900
	Steelhead trout			10,600	10,600
	Sunfish			20,760	20,760
Edenton, N. C.	Large-mouth black bass.		1,500	21,845	23,345
	Catfish			200	200
	Glut herring		95,000,000		95,000,000
	Shad		7,070,000		7,070,000
	Sunfish			2,600	2,600
	Yellow perch		2,450,000		2,450,000
Fairport, Iowa	Large-mouth black bass.			37,487	37,487
	Buffalo fish			168,594	168,594
	Carp			141,368	141,368
	Catfish			386,295	386,295
	Crappie			200,868	200,868
	Sunfish			201,225	201,225
	Warmouth bass			559	559
	White bass			216	216
Gloucester, Mass.	Cod	481,355,000	388,760,000		870,115,000
	Haddock	235,330,000	2,590,000		237,920,000
	Pollock		261,790,000		261,790,000
	Winter flounder		91,460,000		91,460,000
Homer, Minn.	Large-mouth black bass.			154,945	154,945
	Buffalo fish			242,795	242,795
	Carp			3,755,895	3,755,895
	Catfish			2,438,475	2,438,475
	Crappie			8,522,875	8,522,875
	Fresh-water drum			67,020	67,020
	Pike and pickerel			230,000	230,000
	Sunfish			9,257,650	9,257,650
	White bass			18,915	18,915
	Yellow perch			337,580	337,580
	Miscellaneous			206,835	206,835
Atchafalaya, La.	Large-mouth black bass.			2,600	2,600
	Buffalo fish	182,462,500		72,900	182,535,400
	Catfish			233,000	233,000
	Crappie			30,800	30,800
	Pike and pickerel			850	850
	Sunfish			55,980	55,980
	White bass			950	950
	Yellow perch			1,100	1,100
	Miscellaneous			238,000	238,000
Bellevue, Iowa	Large-mouth black bass.			37,155	37,155
	Buffalo fish	99,266,000		13,885,150	113,151,15
	Carp	13,500,000		16,500,600	30,000,600
	Cat fish			3,782,600	3,782,600
	Crappie			312,235	312,230
	Fresh-water drum			21	25
	Pike and pickerel			402	401
	Sunfish			579. 100	579,10

Stations and substations operated and output of each, fiscal year 1924—Continued

Stations and substations	Species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
Homer, Minn.—Contd.					
Bellevue, Iowa—Con.	White bass			437	437
	Yellow perch			3, 676	3, 676
	Miscellaneous			5, 076, 390	5, 076, 390
La Crosse, Wis.	Large-mouth black bass.			148, 505	148, 505
	Brook trout			482, 100	482, 100
	Buffalo fish			7, 926, 514	7, 926, 514
	Carp			12, 270, 770	12, 270, 770
	Catfiish			14, 584, 120	14, 584, 120
	Crappie			7, 939, 055	7, 939, 055
	Fresh-water drum			161, 370	161, 370
	Loch Leven trout			75, 000	75, 000
	Pike and pickerel			375, 025	375, 025
	Rainbow trout			179, 200	179, 200
	Sunfish			10, 771, 911	10, 771, 911
	Warmouth bass			15	15
	White bass			2, 174	2, 174
	Yellow perch			236, 701	236, 701
	Miscellaneous			2, 617, 506	2, 617, 506
Marquette, Iowa	Large-mouth black bass.			95, 105	95, 105
	Buffalo fish			1, 284, 800	1, 284, 800
	Carp			3, 864, 050	3, 864, 050
	Catfish			8, 364, 060	8, 364, 060
	Crappie			5, 090, 500	5, 090, 500
	Fresh-water drum			2, 000	2, 000
	Pike and pickerel			177, 750	177, 750
	Sunfish			4, 198, 300	4, 198, 300
	White bass			691, 600	691, 600
	Yellow perch			51, 225	51, 225
Rock Island, Ill.	Large-mouth black bass.			2, 015	2, 015
	Buffalo fish			125, 570	125, 570
	Carp			161, 010	161, 010
	Catfish			356, 850	356, 850
	Crappie			380, 800	380, 800
	Fresh-water drum			155	155
	Sunfish			693, 600	693, 600
	White bass			155	155
	Miscellaneous			502, 400	502, 400
Yellowstone, Wyo.	Black-spotted trout	*13, 003, 000	6, 193, 500		19, 196, 500
Leadville, Colo.	do			912, 000	912, 000
	Brook trout	(*)		3, 452, 500	3, 452, 500
	Lake trout			84, 000	84, 000
	Loch Leven trout			185, 000	185, 000
	Rainbow trout			12, 400	12, 400
	Steelhead salmon			45, 250	45, 250
Louisville, Ky.	Large-mouth black bass.			250	250
	Rock bass			2, 000	2, 000
	Small-mouth black bass.		522, 000	8, 285	530, 285
	Sunfish			25, 050	25, 050
Mammoth Spring, Ark.	Large-mouth black bass.			64, 300	64, 300
	Rock bass			19, 100	19, 100
	Small-mouth black bass.			48, 100	48, 100
	Sunfish			12, 825	12, 825
Manchester, Iowa	Large-mouth black bass.			3, 500	3, 500
	Brook trout	2, 500		591, 010	593, 510
	Crappie			370	370
	Rainbow trout	*153, 000		181, 816	334, 816
	Rock bass			6, 000	6, 000
	Small-mouth black bass.			6, 400	6, 400
	Steelhead salmon			130	130
Nashua, N. H.	Brook trout			340, 650	340, 650
	Lake trout			32, 496	32, 496
	Landlocked salmon			43, 760	43, 760
	Pike perch		4, 000, 000		4, 000, 000
	Rainbow trout			71, 220	71, 220
	Small-mouth black bass.		3, 800		3, 800

Stations and substations operated and output of each, fiscal year 1924—Continued

Stations and substations	Species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
Neosho, Mo	Large-mouth black bass.			19,538	19,538
	Brook trout			915	915
	Catfish			1,200	1,200
	Crappie			1,756	1,756
	Rainbow trout	* 222,000		228,243	450,243
	Rock bass			5,800	5,800
	Small-mouth black bass.			315	315
	Sunfish			79,003	79,003
	Yellow perch		1,575,000		1,575,000
Bourbon, Mo	Rainbow trout	* 86,886		59,500	146,386
Langdon, Kans	Large-mouth black bass.			33,725	33,725
	Catfish			8,480	8,480
	Crappie			16,471	16,471
	Rock bass			2,425	2,425
	Sunfish			71,325	71,325
Northville, Mich	Brook trout		525,700	22,880	548,580
	Rainbow trout	28,000		102,855	130,855
	Small-mouth black bass.		56,500	6,400	62,900
	Sunfish			1,000	1,000
Alpena, Mich	Lake trout		4,052,000		4,052,000
	Whitefish	3,000,000	30,150,000		33,150,000
Charlevoix, Mich	Lake trout	* 860,000	17,500,000		18,360,000
	Whitefish		35,000,000		35,000,000
Orangeburg, S. C.	Large-mouth black bass.		37,700	229,980	267,680
	Crappie			30	30
	Sunfish			3,595	3,595
	Warmouth bass			3,525	3,525
Put in Bay, Ohio	Carp		28,875,000		28,875,000
	Pike perch	13,825,000	36,000,000		49,825,000
	Sauger		7,392,000		7,392,000
	White fish	* 70,560,000	148,400,000		218,960,000
	Yellow perch		3,915,000		3,915,000
Quinault, Wash	Sockeye salmon	* 3,120,000	1,000,000	3,890,000	8,010,000
	Steelhead salmon		70,000	260,000	330,000
St. Johnsbury, Vt	Brook trout	5,000	531,000		536,000
	Lake trout		89,000		89,000
	Landlocked salmon		15,000		15,000
	Steelhead salmon		15,000		15,000
Holden, Vt	Brook trout		242,370		242,370
	Lake trout	141,646	90,710		232,356
York Pond, N. H	Brook trout	10,357	77,089	51,336	138,782
	Lake trout			300	300
San Marcos, Tex	Large-mouth black bass.			479,310	479,310
	Catfish			2,500	2,500
	Crappie			4,426	4,426
	Rock bass			325	325
	Sunfish			9,995	9,995
	Warmouth bass			420	420
Kerr Co. bass hatchery, Tex.	Large-mouth black bass.			1,040	1,040
Medina Lake, Tex	do			1,038	1,038
New Braunfels, Tex	do			5,105	5,105
Saratoga, Wyo	Black-spotted trout			460,000	460,000
	Brook trout			581,000	581,000
	Loch Leven trout	100,000		211,000	314,000
	Rainbow trout	*323,010		56,000	379,010
Spearfish, S. Dak	Large-mouth black bass.			600	600
	Brook trout			360,100	360,100
	Catfish			900	900
	Loch Leven trout			1,034,500	1,034,500
	Rainbow trout			15,000	15,000
	Steelhead salmon			50,600	50,600
	Sunfish			300	300
Springville, Utah	Black-spotted trout			25,000	25,000
	Brook trout	(*)		196,650	196,650
	Rainbow trout			332,075	332,075
Tupelo, Miss	Large-mouth black bass.		461,500	53,230	514,730
	Crappie			1,200	1,200

Stations and substations operated and output of each, fiscal year 1924—Continued

Stations and substations	Species	Eggs	Fry	Finger lings, yearlings, and adults	Total
Tupelo, Miss—Con.	Sunfish			111,675	111,675
Friar Point, Miss.	Large-mouth black bass.			38,040	38,040
	Catfish			79,690	79,690
	Crappie			42,390	42,390
	Rock bass			22,600	22,600
	Sunfish			1,295,550	1.295,550
White Sulphur Springs, W. Va.	Large-mouth black bass.			47,375	47,375
	Brook trout			735,800	735,800
	Loch Leven trout			129,800	129,800
	Rainbow trout	*100,500		597,884	698,384
	Rock bass			3,800	3,800
	Small-mouth black bass.		14,000		14,000
	Sunfish			2,420	2,420
Woods Hole, Mass.	Cod		3,663,000		3,663,000
	Pollock		1,650,000		1,650,000
	Winter flounder		604,059,000		604,059,000
Wytheville, Va.	Large-mouth black bass.		167,500	16,360	183,860
	Brook trout			90,550	90,550
	Catfish			1,200	1,200
	Rainbow trout	*10,000		110,400	120,400
	Rock bass			22,000	22,000
	Sunfish			31,500	31,500
Yes Bay, Alaska	Sockeye salmon		300,000	25,616,845	25,916,845
Gross output		1,237,582,214	3,863,888,656	260,477,111	5,361,947,981
Loss in transit			41,122	96,205	137,327
Net output		1,237,582,214	3,863,847,534	260,380,906	5,361,810,654

TRANSFERS OF EGGS BETWEEN STATIONS

Every year considerable numbers of eggs are transferred between various stations of the bureau. In each case such transfers are made in the interest of economy and convenience in the distribution of the product.

Transfers of eggs between stations, fiscal year 1924

Species	Number of eggs	From—	To—
Black-spotted trout	1,500,000	Yellowstone Park, Wyo.	Bozeman, Mont.
	1,000,000	do	Glacier Park, Mont.
	1,000,000	do	Leadville, Colo.
	500,000	do	Saratoga, Wyo.
	50,000	do	Springville, Utah.
Brook trout	50,000	Craig Brook, Me.	Green Lake, Me.
	300,000	Leadville, Colo.	Bozeman, Mont.
	400,000	do	La Crosse, Wis.
	500,000	do	Manchester, Iowa.
	500,000	Springville, Utah	Bozeman, Mont.
	400,000	do	Clackamas, Oreg.
	375,000	do	Spearfish, S. Dak.
	200,000	do	La Crosse, Wis.
Chinook salmon	800,000	Mill Creek, Calif.	Battle Creek, Calif.
	360,000	do	Baird, Calif.
	10,000	Clackamas, Oreg.	Central station, Washington, D. C.
	126,000	Little White Salmon, Wash.	Salmon, Idaho.
	350,000	Upper Clackamas, Oreg.	Clackamas, Oreg.
Chum salmon	1,455,000	Brinnon, Wash.	Quilcene, Wash.
	9,410,000	do	Duckabush, Wash.
Cisco	800,000	Cape Vincent, N. Y.	Central station, Washington, D.
Lake trout	25,000	do	Nashua, N. H.
	20,000	do	Craig Brook, Me.

Transfers of eggs between stations, fiscal year 1924—Continued

Species	Number of eggs	From—	To—
Lake trout—Con	6,750,000	Charlevoix, Mich	Duluth, Minn.
	50,000	do	Bozeman, Mont.
	144,000	do	Leadville, Colo.
	50,000	do	Pittsford, Vt.
Landlocked salmon	25,000	Craig Brook, Me	Nashua, N. H.
	25,000	do	St. Johnsbury, Vt.
	212,000	Green Lake, Me	Craig Brook, Me.
Loch Leven trout	102,000	Bozeman, Mont	Erwin, Tenn.
	100,000	do	La Crosse, Wis.
	400,000	do	Leadville, Colo.
	400,000	do	Saratoga, Wyo.
	1,005,400	do	Spearfish, S. Dak.
	200,000	do	White Sulphur Springs, W. Va.
Pike perch	4,000,000	Swanton, Vt	Nashua, N. H.
	8,000,000	do	Cape Vincent, N. Y
Rainbow trout	60,000	Bozeman, Mont	Neosho, Mo.
	25,000	Meadow Creek, Calif	White Sulphur Spring, W. Va.
	82,000	Manchester, Iowa	La Crosse, Wis.
	50,000	Neosho, Mo	Do.
	78,000	do	Nashua, N. H.
	25,000	do	Mammoth Spring, Ark.
	52,000	Bourbon, Mo	La Crosse, Wis.
	53,235	Saratoga, Wyo	San Marcos, Tex.
	75,000	White Sulphur Springs, W. Va.	La Crosse, Wis.
	100,000	do	Northville, Mich.
	25,000	do	Meadow Creek, Calif.
	50,000	Wytheville, Va	Craig Brook, Me.
Silver salmon	5,000,000	Baker Lake, Wash	Birdsview, Wash.
	1,000,000	Birdsview, Wash	Duckabush, Wash.
	1,000,000	do	Quilcene, Wash.
Sockeye salmon	200,000	Baker Lake, Wash	Birdsview, Wash.
	25,000	Quinault, Wash	Medford, Oreg.
Steelhead salmon	25,000	Birdsview, Wash	Leadville, Colo.
	75,000	Applegate, Oreg	Spearfish, S. Dak.
	50,000	do	Duluth, Minn.
	50,000	do	St. Johnsbury, Vt.
	150,000	do	Clackamas, Oreg.
	75,000	Sandy River, Oreg	Do.
Whitefish	43,400,000	Put in Bay, Ohio	Charlevoix, Mich.
	880,000	do	Central station, Washington, D. C.
	17,000,000	do	Cape Vincent, N. Y.

EGG COLLECTING AT AUXILIARY STATIONS

In many instances the eggs hatched at the main stations and also at the substations are derived from temporary collecting fields established for that especial purpose. These field stations are always located as near as possible to the points where egg collections are to be made. In such sections as the Great Lakes and the New England coast regions egg collections are frequently made by means of the bureau's boats.

FISH FOOD USED AT HATCHERIES

The following table shows the amounts and kinds of food used at fish-cultural stations of the bureau during 1924, with the cost per pound of each material used.

Pounds and cost per pound of fish food used during the fiscal year 1924

PACIFIC SALMON STATIONS

Station	Salted salmon		Canned salmon		Salted salmon eggs	
	Pounds	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*
Baird and substations, Calif	10, 200	$0. 02				
Baker Lake and substations, Wash	1, 550	. 021	8, 237	$0. 004		
Clackamas and substations, Oreg	33, 000	. 011				
Quinault, Wash			4, 464	. 035		
Yes Bay, Alaska	1, 800	. 0125	650	. 005	800	$0. 005
Total	46, 550		13, 351		800	

Station	Beef liver		Beef spleen		Sheep liver	
	Pounds	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*
Baird and substations, Calif	660	$0. 09				
Baker Lake and substations, Wash	2, 406	. 077	3, 369	$0. 05		
Clackamas and substations, Oreg			9, 789	0. 45		
Quinault, Wash					1, 388	$0. 06
Yes Bay, Alaska	252	. 10				
Total	3, 318		13, 158		1, 388	

ROCKY MOUNTAIN TROUT STATIONS

Station	Beef hearts		Beef liver		Sheep liver		Hog liver		Cereal	
	Pounds	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*
Bozeman and substations, Mont			6, 249	$0. 063			10, 786	$0. 055	489	$0. 019
Leadville, Colo	2, 886	$0. 038	10	. 18						
Saratoga, Wyo	2, 916	. 045	3, 280	. 055						
Spearfish, S. Dak	1, 500	. 055	27	. 075	4, 730	$0. 055			449	. 01
Springville, Utah	15, 096	. 045	8, 854	. 0425	181	. 05			5, 500	. 023
Total	22, 398		18, 420		4, 911		10, 786		6, 438	

NEW ENGLAND TROUT AND SALMON STATIONS

Station	Beef hearts		Beef liver		Sheep liver		Hog liver		Fish trimmings	
	Pounds	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*
Berkshire trout hatchery, Mass			969	$0. 0866						
Craig Brook, Me	97	$0. 0625	998	. 09	242	$0. 0625	1, 201	$0. 0475		
Nashua, N. H			1, 309	. 0625	4, 771	. 045				
St. Johnsbury, Vt			570½	. 064						
York Pond, N. H			4, 138½	. 054					921	$0. 0353
Total	97		7, 985		5, 013		1, 201		921	

Station	Low-grade flour		Bran		Horse meat		Beef spleen		Cod-liver oil	
	Pounds	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*	*Gals.*	*Cost*
Berkshire trout hatchery, Mass							3, 404	$0. 05		
York Pond, N. H	600	$0. 02325	400	$0. 018¾	137	$0. 0166			1	$1. 60
Total	600		400		137		3, 404		1	

Pounds and cost per pound of fish food used during the fiscal year 1924—Continued

COMBINATION TROUT AND POND FISH-CULTURAL STATIONS

Station	Beef hearts		Beef liver		Sheep liver		Hog hearts		Low-grade flour	
	Pounds	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*
Erwin, Tenn	7,023	$0.055			8,187	$0.05			3,807	$0.026
Manchester, Iowa	3,960	.048			11,660	.045			900	.02
Neosho, Mo., and substations	2,727	.051			13,161	.04	5,033	$0.045	1,200	.0175
White Sulphur Springs, W. Va	10,737	.05	462	$0.051	12,869	.046				
Wytheville, Va	11,785	.055							15,578	.005
Total	36,232		462		45,877		5,033		21,485	

POND FISH-CULTURAL STATIONS

Station	Beef hearts		Beef liver		Mullet		Cereal		Fishotine	
	Pounds	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*
Cold Springs, Ga					4,220	$0.10	382	$0.0205	433	$0.08
Edenton, N. C			21½	$0.20						
Louisville, Ky	482½	$0.10	22	.10						
Mammoth Spring, Ark	1,954	.061								
Orangeburg, S. C	1,944½	.10								
Tupelo, Miss	1,932	.09								
Total	6,313		43½		4,220		382		433	

HATCHERY FISH-CULTURAL NOTES

EFFECT OF CHANGED CONDITIONS ON FISH-CULTURAL WORK IN THE WASHINGTON FIELD

It is evident that there has been no decline in the runs of the various species of salmons in Puget Sound during the past few years. In fact, it is very probable that, with the exception of the sockeye, the runs have increased materially. However, conditions have so changed as a result of lumbering and other industrial activities that it can not be claimed that any of the stations in the Washington field are advantageously located at the present time for the propagation of the chinook or the humpback salmon.

At Baker Lake, where only the sockeye and the silver salmons are propagated, most excellent results are apparent from the fish-cultural operations. There is but little variation in the runs of either species from year to year, and it would appear that the Puget Sound sockeye run has thus far been maintained intact. It may therefore be concluded that the adverse conditions complained of do not exist to any great extent in the Baker Lake field. At every other point in the State the work has been very seriously handicapped as a result of deforestation, and if it is to be maintained at a high degree of efficiency hereafter certain changes in methods will be necessary, which will involve the expenditure of a larger amount of funds than has been available in the past.

At the Birdsview substation conditions are unsatisfactory. Grandy Creek, on which it is located, and the lake which it drains at one time provided excellent spawning areas for large numbers of salmon of various species. Because of deforestation this creek at the present time is almost a negligible factor during most of the year as regards suitable spawning areas for the fall-run salmons. It pursues a sinuous course for a mile or more from the station to its junction with the Skagit River. In this part of the creek, with its widened bed of loose gravelly bars, the first effects of low water stages are apparent. Thus, it frequently happens that the creek, flowing in a comparatively narrow channel through the station grounds, contains sufficient water of suitable depth to permit the ready ascent of spawning fish, while at some distance below the reservation the water spreads out into tiny rivulets on the uneven gravel formation, and the flow becomes so attenuated by seepage that the creek at its mouth appears quite dry.

A practical remedy for this condition would be to divert the flow of the creek from its natural tortuous course and carry it in a straight channel from the station grounds to the Skagit River, a distance of approximately 300 yards. If this were done much greater returns might reasonably be expected from fish-cultural operations.

At the other stations remedial measures are not so readily at hand, and the answer to the demand for a greater amount of fish-cultural work seems to lie in the opening up of new fields. It seems in many cases that the fish, debarred from their wonted spawning areas, have sought other localities not so seriously affected by the changed conditions or offering an acceptable substitute for the places originally selected for spawning. An investigation of a number of such areas, while the large runs of humpback and chum salmon were spawning in the fall of 1923, disclosed the fact that it would be possible to increase the volume of work 100 per cent through a comparatively small increased expenditure. This undertaking would involve the establishment of egg-collecting or eying stations at some of the many points advantageously located for such work and the incubation of the eggs and the rearing of the fry at hatcheries already in existence.

EXTENSION OF THE RUN OF SOCKEYE SALMON

Of passing interest in connection with the work of the Sultan (Wash.) substation was the appearance of three sockeye salmon in the traps on September 23, one of them being a female. While it is known that a few sockeyes (apparently stragglers from other runs) occasionally appear in the Skyhomish River at spawning time, this would seem to be the only recorded instance of their presence in Elwell Creek.

EFFECT OF TURBID WATER ON SALMON EGGS

There are frequent intervals of great turbidity in Grandy Creek, on which the Birdsview (Wash.) substation depends for its egg collections and water supply. Being impressed with the large percentage of infertile eggs handled during such periods, the station superintendent decided to conduct a series of experiments with the view of obtaining definite data on the subject. It was found that the rate of infertility on several lots of eggs washed and hardened in turbid creek water ran from 12 to 13 per cent, while the losses from this cause on eggs taken from the same fish at the same time, but washed and hardened in the creek water after precipitation had freed it from sediment, amounted to not over 7 per cent.

RESULTS ATTAINED IN THE STOCKING OF IDAHO WATERS

During June, 1924, the United States forest examiner, in company with the Idaho State fish commissioner, made an extensive survey of the conditions in a number of streams and lakes under Federal jurisdiction in the State of Idaho, and in connection with this inspection considerable numbers of brook trout, rainbow trout, and landlocked salmon were planted. Shiners were also introduced in practically all waters in which the game fishes were placed with the object of establishing a source of food supply for them.

Practically all of these waters were barren of game fish prior to 1920, when the first plants of the species mentioned above were made. In several of the lakes examined the investigation showed conclusively that the fish planted then and at subsequent periods had become firmly established. Especially was this the case in Alturas Lake, where small rainbow trout in considerable numbers were found, indicating that the introduced fish had spawned there. Abundant evidence of the recent spawning of rainbow trout was also found in Toxaway Lake. In upper Champion Lake, eastern brook trout, planted there for the first time in 1922, now weigh from 2 to 2¾ pounds. Rainbow trout planted in 1920 were found to weigh from 4 to 5 pounds. This lake contains an abundance of natural food, and the brook trout were very fat. In a number of other lakes the fish appeared to be well established, and indications that the results of former plantings had been unsuccessful were found in only a few instances.

GROWTH OF RAINBOW TROUT IN MONTANA WATERS

During the progress of rainbow-trout egg collections at the Meadow Creek (Mont.) substation an interesting feature was the capture of a female rainbow trout 12 pounds in weight. This fish was spawned on May 1 and yielded 43 ounces of eggs at 135 per ounce, or a total of 5,805. It is believed this may be the same large fish that was recorded as having been captured and spawned during the first week of May in the two years previous.

MORTALITY OF FISH IN LAKE ERIE

Visitors arriving at Put in Bay, Ohio, on the passenger steamer leaving Toledo on June 22, reported that they had seen thousands of dead pike perch and saugers floating on the surface of the water between the mouth of the Maumee River and Put in Bay, a stretch of 32 miles. On measuring, some of the dead fish were found to be from 9 to 12 inches in length. The cause of the mortality was generally believed to have been due to pollution carried in the water of Maumee River.

REPORT OF FISH FOOD USED AT THE WYTHEVILLE (VA.) STATION DURING JUNE, 1924

The appended table shows the amount of fish food required at one of the bureau's stations for a period of 30 days, the cost of feeding a specified number of fish of several species, and the cost for food per 1,000 fish of the species mentioned.

Species	Size of fish	Number of fish	Pounds fed per 1,000 fish		Cost per 1,000 fish	Total cost per month	Water temperatures	
			Beef hearts	Mush			Hatchery	Ponds
Rainbow trout	Fingerlings	11,000	3.09	--------	$0.177	$1.947	54.39	--------
	Yearlings	2,330	5.57	29.98	.47	1.095	--------	56.13
	Adults	3,480	58.04	508.9	5.881	20.465	--------	55.68
Brook trout	Yearlings	1,870	5.57	29.98	.47	.878	--------	56.13
Brown trout	do	2,970	5.57	29.98	.47	1.395	--------	59.26
Large-mouth black bass	Adults	225	93.33	--------	5.366	1.207	--------	72.60
Small-mouth black bass	do	24	166.66	--------	9.528	.229	--------	65.83
Rock bass	do	208	19.23	--------	1.105	.229	--------	74.60

A comparison of this information with the results of feeding fish of the same species at other stations of the bureau shows a wide variation in the cost per 1,000. At certain stations having a mean water temperature 10° higher than that indicated above, the cost of feeding the same kind of food was much higher.

COMMERCIAL FISHES

Among the more important commercial fishes propagated by the bureau during the fiscal year 1924 were the salmons of the Pacific coast, the whitefish, cisco, lake trout, and pike perch of the Great Lakes, the carp in the Lake Erie region, such marine species as the cod, haddock, pollock, and flounder, the buffalo fish in the Mississippi Valley region, and such anadromous fishes of the Atlantic coast as the shad, glut herring, and Atlantic salmon.

PACIFIC SALMONS

The outcome of fish-cultural operations at the salmon stations on the Pacific coast shows a considerable decrease as compared with that in 1923. The shortage was caused in part by lack of funds to prosecute the work to its fullest extent in some fields, while in other sections it is attributable to unfavorable weather conditions during the spawning season.

AFOGNAK (ALASKA) STATION

[F. R. Lucas, Superintendent]

In view of the exceptionally small number of sockeye salmon that ascended to the spawning grounds adjacent to the Afognak station in July, 1923, it was deemed advisable to defer active salmon propagation for the period of one year and devote all available funds to extensive repairs, of which the station was in great need. By reason of this decision the output of the year was limited to a small number of fingerling salmon carried over from the previous year's stock, and all sockeyes making their appearance during the summer were given unobstructed passage to the spawning grounds of their own selection in Letnik Lake. The run began on June 6 and extended to September 8, the total escapement for the season numbering 8,025 fish. While it is impossible to assign a definite cause for this material decline from the large runs of recent years, it was ascertained that many salmon were captured in the course of the spawning season near the mouth of the river at Little Afognak, and as the captured fish proved to be similar in size and character to those found in Letnik Bay it was concluded that at least part of the shortage in the run might reasonably be ascribed to that fact.

The annual runs of sockeye salmon to spawning grounds in the Afognak region within recent years have excited unusal interest because of the extraodinary conditions involved. In the early summer of 1912 all spawning fish in Letnik Lake were destroyed as a result of the violent eruption of the Katmi volcano. For several years thereafter only a few salmon entered the lake, though runs of considerable size were the rule prior to the eruption. However, there was a noticeable increase with each succeeding year up to 1919, when a very large run occurred, probably equal in numbers to the average run before 1912. In accordance with the four-year cycle theory another unusually large run was due to arrive in the summer of 1923 but, as stated above, it failed to materialize.

The more important items of repair work accomplished during the year included the laying of new foundation sills and flooring in the large hatchery building. A large amount of construction work was also done on the proposed wagon road, which is to take the place of the tram road leading from the station grounds to tidewater.

The first annual count of the salmon ascending the Karluk River, undertaken in May of the preceding fiscal year, was concluded on October 12, the tally showing the passage of 694,579 salmon upstream in the course of the season.

Dolly Varden trout entered Letnik Lake in the usual large numbers and, following the practice of recent years, persistent efforts were made to destroy them. Drag seines have been found to be the most effective equipment for this purpose, and they were operated to good advantage throughout the season.

During the week beginning October 7, 1923, the station was subjected to a violent wind and rain storm, which resulted in serious damage. The bulkhead protecting the station grounds fronting on Letnik Lake was destroyed throughout several hundred feet of its length and the grounds were badly eroded. The boathouse was entirely destroyed, the 100-foot wireless tower wrecked, and a number of large trees on and adjacent to the reservation were uprooted. The lake reached its highest recorded level during this period.

YES BAY (ALASKA) STATION

[JOHN W. GARDNER, Superintendent]

The results of the year's fish-cultural activities at this station were fairly successful. Operations for the capture of sockeye salmon for propagation work were undertaken on September 6 and diligently prosecuted during the next 15 days, in the course of which 25,550,000 eggs were taken. This figure does not represent all that might have been secured, as, in pursuance of a recently adopted policy, spawn-taking was discontinued when a sufficient number of eggs had been obtained to seed the somewhat limited spawning areas within reach of the station, and the remaining fish were allowed to ascend above the racks to spawn naturally.

Owing to some difficulty with the water supply while the eggs were in the tender stage of development, the losses were somewhat above normal, the total death rate during the incubation period amounting to slightly more than 15 per cent. Early in October the water in the hatchery became heavily charged with gas, its presence being made evident through the formation of masses of tiny bubbles on the baskets and upon the eggs. The constant bursting of the bubbles agitated the eggs, and whenever the slightest jar occurred they were released in sufficient numbers to lift the entire egg mass from the bottom of the baskets. During the night this movement among the eggs caused many of them to accumulate at the lower ends of the baskets, where they were in danger of smothering. The heavy loss occurring during this period appeared to result entirely from the unnatural movement of the eggs while in the tender state, as no injurious effects of the gas other than its mechanical action were discernible. The cause of this abnormal condition of the water supply was not definitely determined, but as it disappeared immediately after fall rains and cooler weather set in, it is supposed to have been a result of the warm dry summer. No prior occurrence of a similar character has ever been experienced at the station.

The artificial feeding of sockeye salmon in the slough pond in Lake McDonald resulted less successfully than last year. This was attributed to the warm dry summer. By the middle of July, when the water temperature in the slough had risen to 69° F., the fish showed evidence of loss of appetite and became restless. In view of the conditions the gates of the inclosure were removed shortly afterwards and the fish permitted to leave at will.

The result of a feeding experiment conducted by the Territorial Fish Commission of Alaska during the year is mentioned as being of interest in connection with salmon culture. Across the narrow neck of a small arm of the sea on Gravina Island, a short distance from Ketchikan, Alaska, a dam was constructed of sufficient height to retain a mean depth of about 4 feet of water at low tide. Extending above high water on the dam, a wire mesh inclosure of approximately 2,000 square feet was constructed, with the intention of retaining therein only such fish as it was desired to introduce. The only change of water in the pond thus formed was brought about by tide action, the inclosure being flooded for an hour or more during high-tide periods, and the entrance of fresh water was limited to the comparatively small amount of surface drainage after rains. Late in February some 50,000 humpback-salmon fry were placed in the pond. The superintendent of the Yes Bay station, who visited this point on two occasions during the spring of 1924, has made the following statement:

> On my arrival at this salt-water pond late in March the fish were just beginning to take food. When I again saw them, on May 17, I was surprised to note their rapid development. There was much variation in size, ranging from 1½ to 4 inches in length, but all of the fish appeared to be in most excellent condition. The artificial foods given were beef liver and immature salmon eggs, both in the fresh state. The total loss on the lot up to the time of my second visit was reported to be about 15 per cent.

BAKER LAKE (WASH.) STATION AND SUBSTATIONS

[JOSEPH KEMMERICH, Superintendent]

Fish-cultural operations were conducted at six points in the State of Washington, and at five of these the work was in progress throughout the year. As heretofore, the Brinnon substation was operated merely as an egg-collecting and eying auxiliary of the permanent hatcheries in the State. The work of the group was addressed to all species of the Pacific salmon, including the steelhead.

While adverse climatic conditions were encountered in certain fields during the spawning season, thereby curtailing the results that might otherwise have been expected, the returns in general were quite satisfactory. The aggregate egg collections for the year amounted to 50,545,000, while the losses of eggs and young fish up to the completion of the distribution period were merely nominal, and all stock handled was liberated in excellent condition. Included in the output are a number of fingerling fish carried over from the previous year's egg collections as well as the product resulting from 1,000,000 eggs of the chinook salmon received from the State hatchery at Kalama, Wash.

Baker Lake (Wash.) station.—This station, picturesquely located on the shore of Baker Lake at the foot of the perpetually snow-capped mountain of the same name, has in recent years built up an enviable record for efficiency in artificial propagation of salmon. From the early days of Pacific salmon culture the importance of the Baker Lake field has been recognized from the fact that it is the only spawning area of the sockeye salmon in the United States proper. This species has been propagated here for many years, and though in certain respects the returns were not altogether satisfactory during the early days of the work it has been developed in recent years to a point of efficiency which, so far as practical results are concerned, is not excelled by that of any similar establishment.

Between July 1 and August 13, 5,408 adult sockeye salmon were taken in the trap maintained at the outlet of Baker Lake for intercepting the run of spawning fish. With a very good run of sockeyes in Puget Sound, suitable water stages in the Skagit and Baker Rivers, and generally favorable climatic conditions a large take of brood fish was anticipated, and under the conditions no satisfactory explanation for the comparatively small number reaching the trap can be found. The fish captured were retained in the inclosure with the usual degree of success, and at spawning time (September 26 to December 5) the females, constituting 49 per cent of the catch, yielded 8,125,000 eggs. Of these 200,000 were shipped, when eyed, to the Government of Chile. Only nominal losses were sustained in the incubation of the remainder, and the resulting fry were carried to the feeding stage in stacked trays, which system is now in general use at most of the Pacific coast and Alaska stations of the bureau.

The run of silver salmon in the Baker Lake field was the largest recorded in the past 10 years. In the belief that these fish are among the more serious enemies of the highly prized sockeye salmon, it has been the bureau's policy to exclude them from the spawning areas of Baker Lake so far as possible. With this in view, all eggs of the species taken there have been transferred to the Birdsview substation to be incubated. Between September 21 and November 26, 6,000 adult silver salmon were taken in the trap used for the sockeye work. This number does not by any means represent the stock available, but owing to the limited capacity of the Birdsview hatchery and the necessity for making all transfers thereto by pack horses, the trap was closed on the last-mentioned date, and the remaining fish, numbering several thousand, were permitted to spawn naturally in Baker River, the trap and its leads effectually barring them from the lake. Of the fish captured 2,619 were females, and from them 7,350,000 eggs were obtained during the period from November 6 to December 15. After the eyespots had developed practically all of these eggs were forwarded to Birdsview, 12 trips with pack horses being necessary to make the transfer.

No important run of chinook salmon has occurred in the Baker River since the inauguration of the bureau's work in that region, but it has always been the policy to secure for propagation all available eggs of that species. Between September 21 and October 25 a small number of brood chinooks entered the trap, 8 of them being females. From this stock 40,000 eggs were taken, fertilized, and placed in process of incubation.

Birdsview (*Wash.*) *substation.*—The extensive lumbering operations prosecuted in the vicinity of the Birdsview substation are proving a serious detriment to the work in that region. The effects of the deforestation that has occurred are made evident by the extreme turbidity of the hatchery water supply after rains, even very light ones, and by alternating periods of drought and flood. Quite frequently the propagation work is materially hampered by one and sometimes by a combination of these destructive influences. During the past year they were unusually aggravated. The Grandy Creek tributary of the Skagit River, on which the substation is located, carried, during a portion of the winter, enough sediment to completely overwhelm the settling tank and filter in the space of two or three hours, and a thickness of 2 to 3 feet of the material was deposited in the rearing ponds within the course of two days.

Aside from the losses of stock and the extra work entailed through the presence of such conditions, another factor, and one having a more direct bearing on the success of the work, was the extended period of low water in the streams at the time brood fish of various species were running. For instance, while the number of brood humpback salmon ascending Skagit River was estimated to be larger than for the past 10 years, the water stage in Grandy Creek was so low as to leave an area of practically bare ground at the point of its junction with the Skagit. Of course, this made it impossible for the fish to enter the creek, though in the past it has been a favorite resort for spawning humpbacks, and no eggs of this species were available. The fish spawned naturally in the main channel of the river and in such of its tributaries as they could ascend.

Similar conditions obtained while the chinook and chum salmons were spawning, and the results were the same, no eggs of either being available. However, 1,000,000 eggs of the chinook salmon were received at Birdsview hatchery from the State hatchery at Kalama, Wash. These were successfully incubated and the resulting fingerlings distributed in suitable localities. Brood silver salmon, running as they do at a somewhat later date than the other species mentioned, met with somewhat improved conditions, and 3,100,000 eggs, taken November 24 and February 13, were obtained, the collection being considerably smaller than last year's. While the run of steelhead salmon was in progress during the spring the water stages were again normal, and about the average collection of eggs was secured. A peculiar feature of the run was that female steelheads outnumbered the males in the ratio of 6 to 1, and owing to this fact certain lots of eggs carried a low percentage of fertility. Spawn-taking operations extended from March 6 to May 16.

Brinnon (*Wash.*) *substation.*—Because of changed conditions along the Dusewallops River as a result of extensive lumbering activities and the erection of dams no fish-cultural work at Brinnon has been possible for a number of years aside from the collection and eying of eggs of the chum salmon. Such work is conducted in Walcott Slough, which also affords an excellent environment for the young salmon. The work at this point during the past year consisted in the collection and partial incubation of 10,980,000 eggs. These were all transferred to the Quilcene and Duckabush substations to be hatched, and the resulting fry were returned for liberation in the slough. The collection—made between November 23 and January 10—exceeded that of the previous year by upward of 3,000,000, the improved results probably being due to the discontinuance of commercial fishing in Hood Canal.

Duckabush (*Wash.*) *substation.*—In connection with its work of road construction, the highway department of the State of Washington found it expedient during the spring of 1923 to alter the course of the Duckabush River near its mouth, and a new channel was excavated to divert the entire flow of the river, thus rendering useless the site the bureau has occupied for many years for the capture of chum and humpback salmon. A trap was therefore constructed in the new channel, and on August 28 chum-salmon propagation was undertaken. Eggs to the number of 5,736,000 were secured from the early run fish in the trap, the last lot being taken on September 20, on which date the collections were terminated by the destruction of the trap through a slight rise in the river, the banks and bed of the new channel being too soft and unsettled to withstand even the comparatively light flood that occurred. Eggs from a second run of this species, which enters the Duckabush several months later than the first one, usually are taken at the permanent barrier maintained on the station grounds, but while this run was in progress the river was at such a low stage that the fish were unable to ascend it.

A disappointing feature connected with the work at the new channel of the river was the failure to secure eggs from a considerable number of humpback salmon, a run of which was coincident with that of the chum salmon. Between September 1 and September 20, 950,000 eggs of this species were secured, and had the trap remained intact a few days longer it is believed that a much larger yield might have been realized. The first silver-salmon eggs of the season were taken November 17, and from that date to February 2 small lots came in at irregular intervals. Owing to the abnormally low water stages prevailing to the end of the season, only a few fish were able to ascend as far as the trap. Practically all of the 704,000 eggs secured were taken from fish seined from the deeper holes and eddies in the river. Silver-salmon eggs from Birdsview and chum-salmon eggs from Brinnon were incubated with the local collections, and during the spring 92,000 steelhead-salmon eggs were collected and hatched.

Quilcene (Wash.) substation.—Between September 3 and October 11 6,365,000 eggs were taken from the early run of chum salmon appearing below the temporary racks installed in the Big Quilcene and Little Quilcene Rivers. A late run of this species occurred in December, and eggs were taken at intervals during most of that month, the total amounting to 1,605,000. The silver-salmon run extended from November 23 to February 12 and yielded 1,520,000 eggs. Eggs of the silver salmon from Birdsview and of chum salmon from Brinnon were incubated at Quilcene with the local collections. During the run of spawning steelheads in the spring there was a period of unusually low water, this being the only unfavorable climatic condition experienced at this point in the course of the year.

The only important improvement at this substation during the year was the laying of a 12-inch wood-stave pipe line to connect the supply tank and rearing ponds, this line taking the place of the old trestle flume, which was unsightly and of insufficient capacity to meet the requirements.

Sultan (Wash.) substation.—The fish-cultural work at this substation suffered more from adverse weather conditions than at any other point in the Washington field. In the fall, when most of the important fishes were spawning, the prevailing low-water stages interfered materially with the work, and serious floods in the course of the winter wrecked the traps, undermined the intake and head gate, and entirely cut off the hatchery water supply. Then followed another period of low water at the spawning time of the steelheads, greatly reducing the egg collections and causing serious inconvenience in the hatchery.

This substation is located on a tributary of the Skyhomish River, and large numbers of both chinook and humpback salmon were present in that stream. Because of the conditions encountered, however, only a comparatively few fish were able to ascend the tributary to their customary spawning areas. Owing to this fact the egg collections of each species were practically negligible, amounting to 610,000 and 30,000, respectively. In the case of the chinook salmon the spawning period extended from September 21 to November 3, while the humpback eggs were taken between September 24 and October 8. While the egg collection of silver salmon was smaller by 50 per cent than last year, it was larger than there was reason to expect in the face of prevailing conditions. Between November 3 and January 30, 2,180,000 eggs of this species were secured.

On February 12 Elwell Creek attained its highest recorded stage. The traps were wrecked and the intake dam and head gate undermined throughout their entire length. Because of the high level of the creek at this time, water continued to flow through the flume to the hatchery, but following a rather sudden lowering of the air temperature on the night of February 15 the water in the creek dropped a foot or more, cutting off the hatchery supply. This necessitated the immediate removal of all baskets of eggs undergoing incubation to a shallow bed in an eddy of the creek, which had been previously prepared for the purpose. The fry and fingerling fish on hand were of necessity liberated in eddies of the creek. By the 16th the flood waters had receded sufficiently to permit of temporary repairs to the water supply, and the stock of eggs was again returned to the hatchery. The collection of steelhead eggs, made between April 21 and May 19, amounted to 98,000, or about one-third the number obtained the previous year.

QUINAULT (WASH.) STATION

[Philo B. Hawley, Superintendent]

The outstanding features of the work at this station were: (*a*) Conduct of the salmon census, (*b*) propagation of sockeye salmon, and (*c*) improvement to ponds and other station property.

Since the run of sockeye salmon in Quinault Lake extends from about April 1 to the end of the succeeding August, it is obvious that the annual report of any fiscal year can not give a complete census of the run of an entire season. The total of the daily counts to the end of the fiscal year 1923 amounted to 123,022, but to this must be added 51,580 fish, the total of the number passing through the weir between July 1 and August 15, 1923, making a grand total of 174,602 fish entering the lake during the full season of 1923. In the spring of 1924 the weir was installed well in advance of the run. The first fish were observed in the trap on March 19, and between that date and the end of the fiscal year the sum of the daily tallies aggregated 109,298.

According to reports received from the superintendent of the Indian Reservation at Tahola, the Indians on the Quinault had taken for commercial purposes or home consumption approximately 100,000 fish from the beginning of the run to June 15. In view of the criticism of the salmon census by many of the Indians, who claimed that the counting weir was responsible for the death of considerable numbers of the adult salmon entering the lake, a careful watch has been maintained during the past two years with special reference to this feature. In this connection frequent trips were made by canoe to points 10 miles or more below the weir in an effort to obtain all relevant facts. The times for making such trips were gauged in accordance with conditions on the river, periods of clear water being especially advantageous, in order that the river bottom might be observed readily. The largest number of dead fish seen on any one trip was 21, and in practically every instance the cause of death was clearly traceable to bites inflicted by seals, either before the fish left the sea or while they were enmeshed in gill nets in the lower reaches of the river. The number whose death could reasonably be attributed to injuries at the counting weir was so small as to be inconsequential.

The minor difficulties developing during the first season's work at the counting weir were soon overcome, and in view of its successful operation since that time it is perhaps not amiss to indulge in speculation as to the advantages that may be expected to accrue from its use as the controlling factor in regulating fishing in the Quinault River. There is probably no other point where the opportunity is so good for controlling and regulating the fisheries with the view of effecting an equitable distribution of the products. Because of their hold on certain favorable fishing locations on the river, either through inheritance or purchase, comparatively few Indians are receiving, under the present system, practically all the monetary returns derived from the fishery, and the amounts that may be earned by less favored though not less industrious individuals seem almost negligible by contrast. This has long been a bone of contention among the Indians on the river.

As a remedy for the present faulty system of managing the fishery it has been suggested that all fishing operations should be conducted at the weir. The following are some of the advantages that might reasonably be expected to accrue from such a procedure:

1. It would be possible to provide for an equal division of the proceeds of the fishing among the Indians now holding fishing rights on the river.
2. The Indians would be put to no expense for the purchase of nets or other appliances.
3. The waste resulting from the present gill-net fishery would be eliminated. Appreciable numbers of fish are annually enmeshed which subsequently escape from the nets, but they are so seriously abraded from their struggles that death ensues before spawning occurs.
4. A certain predetermined percentage of each seasons's run would be assured entrance to the lake and the adjacent spawning areas.
5. The largest fish could be permitted to pass into the lake as potential breeders, to the quite probable improvement of future generations of sockeye salmon. Under the present regulations governing the type of nets that may be used, it is in the main the larger fish that are captured and the smaller ones that escape.
6. The considerable numbers of immature male fish that accompany the annual runs could be marketed and the profits distributed among the Indians. Apparently such fish are of no value as breeders.

The propagation work during the year was limited to the collection of 13,000,000 sockeye-salmon eggs and the development of the product, this number having been previously determined upon as adequate to meet distribution requirements and produce the number of fry that could be properly reared with available facilities. The eggs were obtained without difficulty from the customary spawning areas, and after developing them to the eyed stage, two shipments were made, one consignment of 25,000 being forwarded to the bureau's station at Clackamas, Oreg., and one of 3,120,000 to the Oregon Fish Commission, at Enterprise, Oreg. The remainder were successfully incubated, and the resulting fry and fingerling fish were carried through to the distribution period in excellent condition, there being only one period of heavy loss. This was occasioned by a mishap on the night of April 16, when the head gate in the main water-supply flume was closed in some unknown manner, either through carelessness or possibly with malicious intent. Fortunately the trouble was discovered and remedied shortly after midnight, and a real disaster was narrowly averted. Under the conditions the hatchery was without water long enough to cause some mortality, the fry on trays suffering the heaviest loss.

There appeared to be a very good run of silver salmon and also of the chinook salmon in Quinault Lake, but no attempt was made to collect eggs of either of these species. Because of the entire absence of male fish the preparations made for the collection of steelhead-salmon eggs were without result, and considerable numbers of female fish in spawning condition had to be released from the retaining inclosure without stripping.

CLACKAMAS (OREG.) STATION AND SUBSTATIONS

[HUGH C. MITCHELL, Superintendent]

Fish-cultural work in the Oregon field involved the collection of over 62,000,000 salmon eggs and the successful development and distribution of the product, only normal losses being sustained in any field. A very large percentage of the eggs was of the chinook salmon, the most important commercial fish occurring in the waters of the State. Though eggs of the chum salmon were available in considerable numbers in many of the coastal streams in Oregon, no special effort was made to collect them, it being deemed preferable, for the present at least, to devote the small amount of available funds to the propagation of the more valuable chinook, especially as it is not improbable, in view of the small demand for the chum salmon, that the escapement is sufficient to insure the maintenance of the run of that species through natural reproduction.

A profitable fishing season was experienced on the Columbia River, the estimated value of the salmon taken commercially amounting to $10,000,000. The pack of canned salmon exceeded 480,000 cases, while a large tonnage of salmon in the fresh state was shipped to eastern points and to European countries. In view of the continued success of the commercial fishery of this region, and the rather remarkable returns from marked fish artificially reared at the hatcheries, it seems only just to assume that artificial propagation is proving an eminently important factor in maintaining this highly satisfactory state of the fisheries.

The bureau is again indebted to the State of Oregon for very liberal assistance furnished during the year, financially and otherwise. In the absence of this timely aid the work would have been very seriously curtailed, owing to the bureau's lack of adequate funds. Similar assistance was extended by the States of Washington and Idaho, and this opportunity is taken to express the bureau's appreciation of it.

CLACKAMAS (OREG.) STATION

Clackamas (*Oreg.*) *station.*—Spawn-taking operations on the Clackamas River were more successful than in any previous year, the collections of chinook-salmon eggs in the two fields occupied amounting to nearly 13,000,000. Of these over 11,000,000 were obtained at Clackamas and the remainder on the upper Clackamas River In addition to the work with this species, comparatively small numbers of eggs of the silver and chum salmons were taken at the traps, and eggs of the brook trout and steelhead salmon, acquired by transfer, were also handled. Despitethe fact that the young fish hatched from these eggs were held under more crowded conditions than the best fish-cultural practice warrants, the final results in fingerling fish distributed were very satisfactory. The shipments from Clackamas during the year included a consignment of 200,000 chinook-salmon eggs for the Netherlands Government.

A remarkable occurrence in connection with the fish-cultural work was noted. A lot of 1,500,000 chinook-salmon eggs failed to "water harden" in response to the usual process applied, remaining soft to the end of the incubation period. Notwithstanding this fact, they were successfully hatched and the fry and fingerling fish produced from them were equal in vigor to those more normally developed. So far as is known such an occurrence has never before been experienced.

Upper Clackamas (Oreg.) substation.—The flood of January 6, 1922, practically wrecked this substation, destroying its buildings and rendering the station site quite unfit for the prosecution of fish-cultural work. However, with the view of securing all available eggs of the valuable chinook salmon, a small building was constructed in advance of the spawning season of 1923 to serve as an eying plant, lumber for the purpose being salvaged from the wreckage. The usual success was met with in the collection of eggs, and after developing them to the eyed stage they were transferred to the Clackamas station and the substation was closed for the season.

Little White Salmon (Wash.) substation.—During the year some important changes were made in the station water supply at this point to insure protection against the storms and floods to which this section of the country is subject. The old flume line was abandoned and a new line blasted out of the cliff on the south shore, concrete abutments being constructed to protect its intake. A run of spawning chinook salmon appeared at the racks at the usual time, and egg collections were prosecuted without interruption from September 20 to October 9. The run appeared lighter than usual, and it is believed the intensive fishing conducted in the Columbia River had some effect on its size. Eggs to a total of 14,415,000 were taken, and also 414,000 of the chum salmon. Prior to their liberation the fingerling fish resulting from these collections consumed several tons of salted salmon in addition to 5½ tons of canned salmon and 2 tons of beef spleen.

Big White Salmon (Wash.) substation.—Brood chinook salmon in very fair numbers appeared on the usual spawning areas in the Big White Salmon River and Spring Creek, and from them 7,205,000 eggs were collected. A hole cut in the rack by beavers during a period of turbid water, when the damage was not discernible, permitted some of the fish to escape, thereby reducing the collections to some extent. In addition to salmon propagation, a considerable amount of work was done for the State of Washington in incubating eggs of the brook trout, rainbow trout, the so-called "silver trout," and the steelhead salmon. The young fish resulting from this stock were also held and cared for until the distributions could be made by State employees.

Rogue River (Oreg.) substation.—The output of this station was 6,136,700 fingerling fish, and approximately 1,000,000 eggs and fry were still on hand at the end of the year. The work was concerned with the chinook, silver, sockeye, steelhead, and landlocked salmons, and the black-spotted trout, consignments of eggs of the two last-named species being received from Maine and the Yellowstone National Park, respectively. About one-third of the chinook-salmon eggs collected were secured on the new spawning grounds in Big Butte Creek. The run of silver salmon was well above the average, and 2,235,300 eggs were obtained and incubated. For several seasons past eggs of the steelhead salmon have not been available in large numbers at this point. The collection during the year amounted to 506,600.

Applegate Creek (*Oreg.*) *substation.*—Early in the year retaining corrals of a combined area of 6,000 square feet were built along the north shore line below the barrier in Applegate Creek and were very successfully used during the succeeding runs of silver and steelhead salmon for holding immature fish pending the ripening of their eggs. Climatic conditions at this point were very unfavorable to fish culture. As there was almost a complete absence of rain, the water level in the creek throughout the entire year was never above the normal summer stage, and there were only a few days when it was high enough to give fish ready access to the traps. Notwithstanding this drawback the results of the season's fish-cultural work compare favorably with those of recent years. In the course of the fishing season, extending from November to May, 5,476,000 eggs of the silver salmon and 3,504,000 of the steelhead were secured. No ill effects from the low water level were noticeable while the eggs were undergoing incubation, though the liberation of the steelhead fingerlings carried over from the preceding year at an unusually early period was necessitated. The distributions from this substation included shipments of eyed eggs to Hawaii, Czechoslovakia, Poland, France, and to a number of State hatcheries.

Sandy River (*Oreg.*) *substation.*—Since the Portland Electric Power Co. has extended the walls of its canal to a point where the entire flow of the river may be diverted, there are times when fish-cultural operations at this point are quite impracticable. In fact, it is not uncommon to find the river bed dry for a distance of 8 miles or more, and it seems to be only a matter of time when this once beautiful stream will be quite devoid of its famous salmons and trouts. Fortunately, the run of steelhead salmon occurs in the early spring months, and owing to this fact the species may be able to maintain itself in the river for a much longer period than the species running at other seasons of the year.

The year's egg collections, obtained under most difficult conditions, amounted to 1,823,918 of the chinook, silver, and steelhead salmons. From this stock a good percentage of fish was realized for distribution.

Salmon (*Idaho*) *substation.*—As at other points in the field subordinate to the Clackamas station, a successful season's fish-cultural work was experienced at this substation. From local streams, including the Pahsimeroi River and Lemhi Creek, approximately 9,500,000 chinook-salmon eggs were taken, and as the rearing capacity of the Salmon hatchery was not large enough to accommodate all of them, the surplus eggs had to be transferred to points nearer the coast for incubation. However, it is not considered good fish-cultural practice to ship salmon eggs from the upper tributaries of the Columbia River to points nearer its mouth, and with the view of obviating this necessity in the future an effort is being made to increase the hatching and rearing facilities at Salmon so that all eggs taken in that region hereafter may be cared for locally.

By way of experiment 125,000 chinook-salmon eggs were sent from the Little White Salmon station to the Salmon hatchery. It is planned to mark some of the fish resulting from these eggs before releasing them for the purpose of ascertaining if the homing instinct of these so-called "fall run" fish will be strong enough to induce them to ascend the Columbia and Snake Rivers to a point hundreds of miles above the tributary selected as spawning grounds by their parents. In the course of the year a consignment of rainbow trout eggs was handled at the Salmon station for the Idaho fisheries authorities.

BAIRD (CALIF.) STATION AND SUBSTATIONS

[W. K. HANCOCK, Superintendent]

The results of the fish-cultural work at stations in the California field were again materially curtailed by adverse climatic conditions. In contrast to the severe floods, which occur so frequently in the fall months, the fiscal year 1924 is noteworthy because of an almost continuous drought, the period of dry weather having been the most protracted experienced in this region in many years. Not once during the year did any of the streams on which the bureau's work is conducted even approach the high-water stage, and the consequences are evident in the reduced egg collections. The prevailing low water in the lower stretches of the Sacramento River favored the operations of the commercial fishermen, and the comparatively small numbers of chinook salmon escaping the nets were forced to spawn on riffles in the main river rather than on their usual spawning grounds in its tributaries.

Baird (*Calif.*) *station.*—Notwithstanding the unfavorable outlook for eggs, racks were installed in the McCloud River in April to intercept the spring run of chinook salmon, the existing low-water stages being favorable to such work. Taking all influencing factors into consideration, including the irrigation dam in the Sacramento River, a gratifying number of salmon reached the racks, and from them 1,000,000 eggs of the spring-run chinook salmon were obtained, the collections extending from September 9 to October 13. Because of the drought no water from the gravity source of supply was available for hatching operations at any time during the year, and to obviate the expense of pumping water troughs were set up near the mess house and the supply drawn from the small spring pipe line ordinarily used for domestic purposes. In this manner the eggs were successfully held to the close of the incubation period. From that time until the distributions were made, the hatchery was supplied with water by pumping.

Battle Creek (*Calif.*) *substation.*—Early in the year the matter of collecting eggs of the spring-run chinook salmon in Battle Creek was again arranged for. As was mentioned in a previous report, the site selected for this work is just below the dam of the Coleman Light & Power Co., about 4 miles above the Battle Creek hatchery. Though the work was undertaken on an experimental basis and conducted under most trying circumstances, 446,000 eggs of good quality were secured and sufficient experience was gained to demonstrate conclusively that under more normal climatic conditions profitable collections of eggs can be made at this point. The eggs taken were obtained between September 8 and 28.

The customary fishing operations in the vicinity of the Battle Creek hatchery were taken up in October, and from October 25 to December 4 the total collection of eggs for the season amounted to 1,620,000.

Mill Creek (*Calif.*) *substation.*—As an illustration of the severity of the drought prevailing at this substation, it may be stated that on

September 10, when the racks were installed in Mill Creek, they were placed on the dry bed of the stream with as little difficulty as would be experienced in placing them on any level stretch of land. Fishing and spawn-taking operations were in progress at this point from October 27 to December 5, inclusive, and 3,012,000 chinook eggs of good quality were the result, the collection being surprisingly large in view of the conditions encountered.

GREAT LAKES FISHES

The geographical range of the bureau's operations coming under this head extends from the Rainy Lake region, in Minnesota, to Lake Champlain, in Vermont, and the species to which especial attention is paid are the whitefish, lake trout, cisco, pike perch, and carp. Eggs of the yellow perch are also handled.

The total output of the group during the fiscal year 1924 was approximately 761,000,000 eggs and fry, as compared with 671,000,000 in round numbers in 1923. The increase is principally accounted for by the larger number of cisco eggs obtained in the Lake Ontario field and the pike-perch eggs secured at the Swanton (Vt.) substation. The aggregate collections of lake-trout eggs also slightly exceeded those of the previous year.

DULUTH (MINN.) STATION

[S. P. WIRES, Superintendent]

During the early fall arrangements were made by the force of the Duluth station for the collection of lake-trout eggs at all points on Lake Superior where there was a likelihood of securing them on a profitable basis. The spawning season opened September 25 at Washington Harbor and at other points on Isle Royale, Mich., and the last eggs were obtained on November 25, though the bulk of the collections had ceased by November 13. The aggregate results were 14,793,500 eggs of average quality, to which were added, on November 24, 7,000,000 green eggs taken in the Charlevoix (Mich.) field. As only about 45 per cent of the last-named lot were good, the losses sustained on the stock as a whole would appear to be abnormally heavy. On reaching the eyed stage a total of 825,000 were shipped to various State fish hatcheries; the remainder were incubated, producing 11,982,000 fry and fingerling fish for distribution, most of which were returned to the spawning grounds in Lake Superior from which the eggs were derived.

While the lake-trout work was in progress 3,840,000 white-fish eggs were secured, being collected at intervals by commercial fishermen operating in the vicinity of Isle Royale. Additional eggs of this species to the number of 21,660,000 were turned over to the Duluth station by the State Game and Fish Department of Minnesota. All of this stock was somewhat below the average in quality, owing to unfavorable weather conditions during the spawning season. From it 13,000,000 fry were hatched and planted on whitefish spawning grounds in Minnesota, Michigan, and Wisconsin waters.

Through cooperative work with the Minnesota fisheries authorities approximately 18,000,000 pike-perch eggs were obtained, the collections being made in the Rat Root River, near Ericsburg, Minn. The eggs were apparently of good quality when received, but subsequent losses so reduced the stock that only 1,450,000 fry were realized for distribution.

This station also distributed the product of 346,000 brook-trout eggs purchased from commercial fish-culturists in Pennsylvania and Colorado and 41,000 fingerling steelhead salmon hatched from a consignment of 50,000 eggs transferred to the Duluth hatchery by the Oregon State Game Commission.

In the course of the year an attractive cottage was constructed for the use of the station foreman. Most of the finish work on the second floor of this building was done at odd times by the station employees.

NORTHVILLE (MICH.) STATION AND SUBSTATIONS

[W. W. THAYER, Superintendent

The year's fish-cultural work at the Northville station consisted in the propagation of small-mouth black bass and the hatching and rearing of brook and rainbow trout fry and fingerlings from eggs furnished the hatchery from outside sources. During the early winter of 1924, 619,260 brook-trout eggs were acquired, 350,000 being purchased from private fish-culturists in the East while the remainder were donated to the bureau by the Pennsylvania Fish Commission, being taken from the stock in the Pleasant Mount hatchery operated by the State. Fry and fingerlings to the number of 548,580 were produced from these eggs and distributed, the losses during the time they were held amounting to slightly less than 11½ per cent of the original number.

From a total of 211,695 rainbow-trout eggs, part of which were furnished from the White Sulphur Springs (W. Va.) station and part from the Paris hatchery operated by the Michigan Fish Commission, one consignment of 28,000 was reshipped to an applicant, 102,855 fingerling fish were produced and distributed, and a considerable number of fingerlings remained on hand at the end of the year.

The unseasonably late spring hampered the work with the pondfishes and greatly curtailed the output. The brood stock of 199 small-mouth black bass was distributed in the breeding ponds on May 6. The fish began nesting on the 12th, and by May 22 the ponds contained 47 nests of bass fry. It is believed, however, that all of these earlier hatched fish perished as a result of the prevailing low water temperatures, which up to that date had not exceeded 58° and for a large portion of the time were considerably lower. Mild weather set in near the end of May, and air and water temperatures from that period to the close of the season were favorable. The fish continued to spawn up to and including June 17, and from the 31 nests of eggs realized there was an output of 56,500 advanced fry. The brood fish at this station are somewhat below the average size. With the view of producing a greater output a special effort will be made in advance of the next spawning season to secure brood fish of larger size from Lake Huron.

Charlevoix (Mich.) substation.—During the period from October 22 to November 26, 54,012,000 lake-trout eggs were obtained from commercial fisheries in Lake Michigan, Lake Huron, and the Straits of Mackinaw for stocking the Charlevoix hatchery. Their quality was no better than in past years, and the usual heavy losses were sustained in the course of the incubation period. There being no limitation as to the number of nets operated, the fishermen in some instances set more nets than they were able to lift at proper intervals, with the result that part of the fish in them were either dead or the quality of their eggs impaired. With the view of obviating faulty methods in taking and handling the eggs, steps were taken in the course of the season to instruct the crews of the various fishing boats as to the proper procedure in stripping fish, fertilizing the eggs, and caring for them pending their delivery to agents of the bureau. However, the spawn taker selected for this duty arrived on the fishing grounds too late to be of much service during the current season, but the work was started, and it is planned to pursue it on a systematic basis from the beginning of the next spawning period.

Of the eggs collected 6,750,000 were shipped in the green state to the Duluth (Minn.) hatchery, and eyed eggs to the number of 904,000 were furnished to applicants and other stations of the bureau. The remainder were incubated, producing 17,500,000 fry for return to the native spawning grounds.

Whitefish eggs to the number of 19,840,000 were collected between November 15 and November 29, and 53,400,000 were transferred to the hatchery from the Put in Bay (Ohio) field. From this stock 35,000,000 fry were hatched and planted.

Alpena (Mich.) substation.—Owing to the improved quality of the hatchery water following the completion of the city filtration plant, whitefish and lake trout propagation was conducted under much more favorable conditions than have prevailed at this substation for several years. Active fish-cultural work began on October 29 with the receipt of the first lot of lake-trout eggs, and from then until the close of the spawning period, on December 11, 7,824,000 of this species were secured. Collections of whitefish eggs were made between November 8 and November 28, the total for the season amounting to 48,880,000. The entire stock of both species was obtained from fisheries in the vicinity of Alpena, and, as compared with the yield from these grounds a few years ago, the collections may be regarded as successful. The improved results are largely attributable to a better cooperative spirit on the part of the commercial fishermen. The State game warden also rendered material assistance in the work. After reaching the eyed stage, 3,000,000 of the whitefish eggs were turned over to the Michigan Conservation Commission. The remainder were incubated in the Alpena hatchery, and all of the resulting fry were released on the spawning grounds from which the eggs were derived.

PUT IN BAY (OHIO) STATION

[DAVID DAVIES, Superintendent]

With the approach of the whitefish spawning season in early November men were stationed at the various fishing centers in Lake Erie, and the usual arrangements for obtaining eggs for the hatchery were effected with the commercial fishermen. Between November 12 and December 6, eggs to the number of 313,200,000 were received, of which 250,320,000 came from the Port Clinton and North Bass fields. The remainder were derived from the fisheries at Middle Bass, Catawba Island, Put in Bay, and Toledo. No nets were operated in the formerly prolific field around Monroe Piers, Mich., owing to the poor results attained there in recent years. The cause of the failure here has not been definitely ascertained. Some of the fishermen have attributed it to the discharge of pollution into the lake from the Maumee, Raisin, and Detroit rivers, while others claim that so many gill nets were set across this portion of the lake that the passage of the fish to their spawning grounds in its western end was effectually cut off.

Shipments of green whitefish eggs to the number of 78,760,000 were made to other hatcheries, 9,680,000 of inferior quality were planted on the reefs near the hatchery immediately after being fertilized, and 5,760,000 eyed eggs were forwarded to the Lincoln Park Zoo at Chicago, Ill. From the remainder, 148,000,000 fry were realized, the proportion of hatch being slightly more than 67 per cent of the retained eggs. All of these were released in the lake at points ranging from 2 to 12 miles distant from the hatchery.

On April 3, nearly three weeks after the legal opening of the pike-perch fishing season, the spawning grounds in the western end of Lake Erie were still covered with ice, which interfered with the setting of nets. In some instances the fishermen placed their nets where open water was found, with the result that many of them were destroyed by ice fields with the shifting of the winds.

Despite the unfavorable prospects, spawn takers were stationed at the various collecting centers at the usual time, though no eggs were available until April 19. Between that date and May 3 a total of 117,425,000 eggs were received, nearly all of them being taken at the Toledo and Port Clinton fisheries, these fields yielding 72,625,000 and 36,575,000 eggs, respectively. Green eggs to the number of 13,825,000 were forwarded to the Iowa State hatchery, and from the remainder 36,000,000 fry were hatched and liberated.

Although the fishermen had been requested in advance of the pike-perch spawning season to save all available eggs of the sauger and yellow perch, only 8,400,000 of the former and 4,350,000 of the latter were secured. It is believed the collections of these species would have been much more satisfactory had weather conditions not interfered. In each instance the eggs were of good quality, yielding a good percentage of strong vigorous fry. The sauger eggs were eyed in 7 days, and incubation was completed at the expiration of 10 days additional in a mean water temperature of 51°.

As with the other spring-spawning species, the results of carp propagation in the Port Clinton and Sandusky Bay fields were quite disappointing. The commercial fishermen captured only about one-half the number of fish taken the previous year, and egg collections were correspondingly reduced, the total take amounting to 41,825,000, or about one-fourth that obtained in June, 1923. It would appear that the unfavorable natural conditions had the effect of reducing the run of fish to their customary spawning grounds. Egg collections of this species were made between June 5 and June 30.

CAPE VINCENT (N. Y.) STATION AND SUBSTATION

[J. P. SNYDER, Superintendent]

The active fish-cultural work of the year at the Cape Vincent station began in early October with the collection of lake-trout eggs, the fields occupied being Pigeon and Simcoe Islands on the Canadian side of Lake Ontario, and Stony Island in New York waters. The collections extended from October 16 to November 9 and resulted in 1,098,000 eggs, or about 200,000 less than were secured in these fields the preceding year. The decrease was attributed to a smaller catch of fish and to unfavorable weather during the spawning season.

Whitefish egg collections were seriously curtailed by the refusal of the deputy minister of fish and game of Ontario to permit the bureau's men to secure eggs in the important fields formerly occupied in the Bay of Quinte and along the lake shore near South Bay. It appears that this action was not taken in a spirit of antagonism, but was prompted by a desire to secure all possible eggs for filling the hatchery recently constructed by the Canadian Government at Glenora, Ontario. The bureau's men were allowed to make egg collections of all species at Simcoe Island and at Brighton and Bowmansville, Ontario, and the whitefish eggs secured at these points, together with those obtained at the usual points of collection on the American side of the lake, aggregated 95,258,000. The station also received 17,000,000 from Lake Erie, but they were of very poor quality. The eggs obtained in Chaumont Bay and in the vicinity of Cape Vincent exceeded the collection of any previous year in these fields. As a rule, they were of excellent quality.

In addition to the fields heretofore occupied in the search for eggs of the cisco, the operations were extended to Big Sandy Pond, N. Y., and to the Simcoe Island and Wellers Bay fields on the Canadian side. Plans were also effected to send men into the Bay of Quinte, but before any definite action had been taken it was learned that the run of fish in that field was too small to justify the expense involved. The spawning season covered the period from November 17 to December 5, during which time 200,790,000 eggs were secured. Most of the fry resulting from these eggs were planted on the cisco spawning grounds in Lake Ontario and adjoining bays, the number thus disposed of amounting to 128,360,000.

Somewhat heavy losses were incurred as a result of the efforts made to remove a growth, of vegetable origin, which developed in considerable quantities on the whitefish and cisco eggs undergoing incubation. The additional handling and frequent washings to which the eggs were subjected in this process not only impaired their quality, but some of them were washed away despite the precautions taken to prevent it. In an effort to check the growth, copper sulphate was used experimentally and with good results where the eggs were at an early stage of development. When used on those at an advanced stage, however, prematurely hatched fry in a weakened condition were the result.

Some losses also occurred as a result of minnows coming in through the pumps and lodging in the jar faucets, cutting off the flow of water. These were very troublesome at times, and to exclude them from the jars it became necessary to employ a different type of screen from that ordinarily used, with heavier and coarser wire cloth for the battery troughs. Even under this arrangement the screens had to be emptied and cleaned at frequent intervals, but the stream of minnows was not continuous for long periods, and sometimes for a week or more there would be no trouble from this source.

In the early winter of 1924, 749,000 brook-trout eggs were received by purchase from commercial hatcheries, and 436,000 were furnished the station by the Pennsylvania Fish Commission in payment for cisco eggs supplied to that State in past years. The Pennsylvania eggs were unusually large and highly colored, and the fry were correspondingly large and very vigorous. At the close of the fiscal year a considerable number of young brook trout were being held in troughs supplied with water from the city works in an effort to rear them to a larger size before planting. One hundred thousand rainbow-trout eggs were received from the State of Michigan in return for cisco eggs previously furnished that State, and 8,000,000 eyed pike-perch eggs were transferred to Cape Vincent station from the Swanton (Vt.) substation. The fry from all these eggs were used to supply applicants and to make plants in public waters.

It has been the practice in past years to distribute all brook and rainbow trout fry produced at this station in the fry stage. This procedure having been the cause of a great deal of dissatisfaction on the part of applicants receiving the fish, it was determined during the year to locate, if possible, a suitable site for a field rearing station, one where an abundant supply of water of good quality would be available for the work. With this in view, the station superintendent has inspected a number of sites, but thus far he has found none that is well adapted to the purpose.

SWANTON (VT.) SUBSTATION

[J. P. SNYDER, Superintendent]

Owing to lack of sufficient funds for its operation, this substation remained closed throughout the fiscal year 1923. It was opened early in April, 1924, and fitted up preparatory to undertaking pike-perch propagation on a cooperative basis with the States of Pennsylvania, Connecticut, and Vermont. Pennsylvania and Connecticut agreed to furnish most of the funds required, receiving in return therefor 50 per cent of the eggs collected; the bureau assumed a portion of the expense and provided the services of a competent fish-culturist to direct the operations, while the State of Vermont furnished the services of a man to assist in the hatchery.

The spring was unusally late, but as soon as ice conditions would permit seining operations were started, and two large traps and five small ones were set at suitable locations on the spawning grounds in the vicinity of the hatchery. Brood pike perch were taken before the total disappearance of the ice in the lake, and with them numbers of black and red fin suckers, mullet, catfish, and sheepshead; also, in smaller numbers, whitefish, ling, gar, black bass, sand pike, pickerel, bullhead, smelt, and sunfish. These fishes were sold by the fishermen, the State of Vermont having granted this privilege to compensate them for the brood fish turned over to the hatchery as a source of egg supply.

The existing shortage of male fish was overcome by the operation of seines in the Missisquoi River, 536 males and 120 additional females being secured from that source. Spawn taking extended from April 14 to May 5 and resulted in 185,850,000 eggs, the number being arrived at by measuring them when 24 hours old and estimating 150,000 to the quart. As the fish were spawned they were liberated in the lake. Many of the females, particularly the large ones, showed evidence of distress in the retaininig inclosures from the beginning. They seemed unable to maintain a balanced horizontal position under the water and showed an inclination to swim about with their tails above the surface of the water. However, the loss was not heavy until near the close of the season, when it became necessary to release many that had not spawned.

Seventy-eight million green eggs, the share of the Pennsylvania Department of Fisheries, were delivered at their hatchery in good condition and were reported later as having hatched with a loss of about 25 per cent. After reaching the eyed stage 5,180,000 were turned over to the Connecticut State hatchery and 12,000,000 were consigned to the bureau's stations at Cape Vincent, N. Y., and Nashua, N. H. The remaining eggs were hatched at Swanton, yielding 22,000,000 fry, of which 7,200,000 were turned over to the Vermont Department of Fish and Game, 7,800,000 were distributed to applicants, and 7,000,000 were returned to the spawning grounds from which the parent fish were derived.

Incidental to the pike-perch work 11,000,000 eggs of the yellow perch were taken, the collections extending from May 1 to May 12. Of the 10,300,000 fry produced from them 1,800,000 were supplied to applicants and 8,500,000 were furnished to the State of Vermont.

BRYANS POINT (MD.) SUBSTATION

[L. G. HARRON, Superintendent]

The work of collecting a brood stock of yellow perch for this substation was taken up on March 5 and continued to March 22. During this period 22,974 adult fish were secured and placed in the retaining pens. Spawning began on March 23 and continued to April 2, by which time a total of 203,970,000 eggs had been deposited. There was a loss of approximately 13 per cent on the brood fish while confined. The eggs yielded 193,769,000 fry of excellent quality.

RESCUE OPERATIONS

HOMER (MINN.) STATION AND SUBSTATIONS

[C. F. CULLER, in charge]

The more important work of this group of stations, which includes the Homer (Minn.) station as the administrative office and the substations at La Crosse, Wis., Marquette and Bellevue, Iowa, and Atchafalaya, La., consists of the so-called rescue operations, or the removal of valuable food and game fishes from the landlocked ponds and sloughs formed by the receding waters of the Mississippi River after the annual spring freshets and their liberation in the main channel of the river. During the fiscal year 1924 such work was actively pursued at suitable points between Prescott, Wis., and

Andalusia, Ill., and in the vicinity of Atchafalaya, La. The total number of fish removed from drying pools and sloughs was 150,509,840, and all of these were returned to their native waters with the exception of 1,095,559, or slightly more than one-half of 1 per cent of the aggregate, this comparatively small fraction of the total representing the fish that were diverted from the rescue work to meet the requirements of applicants in various parts of the country.

In connection with the rescue work the practice within recent years of infecting suitable host fishes with the glochidia of the commercially important fresh-water mussels was again taken up, and as a result of the work 1,335,595,000 larval mussels were released in a state of parasitism in waters favorable to their development and growth.

The Mississippi River did not attain as high a stage as usual during the spawning season of the native food and game fishes. As a consequence a smaller area of the adjacent lowlands than formerly was overflowed, and the receding waters naturally left a much smaller number of pools and ponds. Because of such conditions it was predicted early in the season that the results of the rescue work would fall short of the average numbers. As it progressed, however, it became apparent that, while the area of backwaters in which fish were stranded was considerably smaller than in some seasons, the fish population of such waters as were accessible was very dense. The effects of this density were made manifest in the serious mortality that occurred at many points and by the smaller average size of the young fish taken. Summarized tabular statements of the rescue and mussel infection operations appear on pages 370 and 404.

While commercial fishing for buffalofish and carp was in progress in the vicinity of Bellevue, Iowa, the bureau's spawn takers collected and fertilized upward of 99,000,000 buffalofish eggs and 13,500,000 eggs of the carp. These eggs, which otherwise would have been a total loss, were deposited immediately after being fertilized on the local spawning areas.

In view of the vast importance of the fishes involved in the bureau's rescue operations, the facility with which they may be prosecuted, the low cost of the work as compared with the results attained, and the unquestioned benefits accruing therefrom it seems particularly unfortunate that the small amount of money annually available for the purpose can not be augmented sufficiently to permit of an extension of the work, at least to the extent that the fields now occupied may be fully covered.

The season under discussion is an illustration of the desirability of more extended rescue work. Because of the rather unusual conditions, which have been explained elsewhere, millions of young fish were densely crowded into restricted waters, the areas of which were constantly and rapidly diminishing through evaporation and seepage. Under such conditions the mortality among these fishes must obviously be very great, and the only remedy lies in removing them from their unnatural environment and liberating them in the river.

Of added interest and value to this work are the recently adopted measures for mussel infection in connection therewith. By means of it enormous numbers of larval mussels are provided with suitable host fishes, without which they can not survive this stage of their existence. The work is most heartily indorsed by all interests concerned, including the Izaak Walton League of America, the pearl-button industry, which is directly dependent on the supply of fresh-water mussels for its raw material, and the commercial fishing interests generally.

La Crosse (*Wis.*) *substation.*—In addition to the rescue and mussel-infection work accomplished at the La Crosse (Wis.) substation, eggs of the rainbow trout from Neosho (Mo.), Manchester (Iowa), and White Sulphur Springs (W. Va.) stations, brook-trout eggs from a commercial breeder, Loch Leven trout eggs from the Bozeman (Mont.) station, and pike-perch eggs from the State of Minnesota were incubated and the resulting fry distributed to applicants in Wisconsin and Minnesota.

Atchafalaya (*La.*) *substation.*—The substation at Atchafalaya, La., was opened early in February and the necessary arrangements made for the collection of eggs of the buffalofish. The work of last season verifies beyond a doubt that a new location must be found if success is to be attained in the artificial propagation of this fish. Trouble of a similar nature has been encountered each succeeding year since the substation was established.

Through the course of the work in 1924 a careful check on all probable causes of the mortality was made, and there can no longer be a doubt that the trouble is attributable to pollution carried in the waters of the Ouachita River, which drains the southern Arkansas oil fields.

Several other possible sites were visited, two of which—Bayou Grosse Tete and Bayou Plaquemine—appear to offer the essential requirements for successful work. The station should be moved to one of these locations before the propagation of buffalofish is taken up next season.

Active egg collections began on March 6, and though climatic conditions were not at all favorable at any time during the spawning season 277,512,500 eggs had been secured by March 29, which date marks the close of the egg collections for the season. Repeated attempts to incubate the eggs at the hatchery proved futile. Fertilized eggs placed in the hatching jars in good condition showed a small white spot at the end of 24 hours, and in 48 hours all eggs were white and opaque. Because of this unfortunate situation it was necessary to plant the fertilized eggs on the spawning grounds immediately after they were impregnated.

MUSSEL INFECTION IN CONJUNCTION WITH THE RESCUE OF LAND-LOCKED FISHES

[H. L. CANFIELD, in charge]

Owing to the unusually small size of the fishes handled early in the rescue season, the mussel work was not undertaken until larger and more vigorous fishes were obtainable. As a consequence of this delay the results were considerably curtailed as compared with last year. The total number of mussel glochidia released on the gills of living fishes in the course of the season amounted to 1,335,595,700, indicating a falling off of upward of 713,000,000. The work is conducted at a minimum outlay of labor and time, the operation being performed just prior to the release of the fishes from the tubs into open waters. Its cost during the season of 1924 amounted to an average of $0.0011 per thousand, or less than half the average of the preceding year.

The bureau received a gratifying amount of cooperative assistance from clam fishermen and others engaged in the industry, and from reports furnished by the fishermen it is believed that the work is producing valuable results in maintaining the supply of mussels in certain areas. The following summary shows the fields in which mussel operations were prosecuted in 1924 and the number and species of mussels handled in each.

Summary of infection of fishes, fiscal year 1924

Stations	Species		
	Grass mucket (*L. luteola*)	River mucket (*L. ligamentina*)	Pocketbook (*L. ventricosa*) [1]
Alma, Wis		63,700	
Minnieska, Minn		11,364,300	
West Newton, Minn		3,747,000	
Chimney Rock, Wis		24,732,000	
Winona, Minn		78,510,000	
Homer, Minn	21,682,500	312,968,100	
Dakota, Minn		6,236,000	
La Crosse, Wis	92,390,000	107,689,500	
Genoa, Wis	94,250,000	253,750,000	24,750,000
Ferryville, Wis	154,000	3,179,000	
Lynxville, Wis	17,120,000	246,167,500	
Marquette, Iowa	1,089,000	1,313,500	
Guttenberg, Iowa		4,841,000	
Bellevue, Iowa	7,032,900	22,190,700	
Buena Vista, Iowa		375,000	
Total	233,718,400	1,077,127,300	24,750,000

[1] This mussel is not first class in quality and fishes are infected with it only when first-class mussels are not available.

MARINE FISHES

Taken as a whole, the fish-cultural work of the marine stations may be regarded as successful, the total egg collections of the group being nearly 25 per cent greater than in the preceding year. This increase was made possible by the large collections of winter-flounder eggs obtained, all of the stations engaged in this branch of the work securing them in much larger numbers than last year. On the other hand, there was a shortage of nearly 267,000,000 cod eggs, as compared with last year, this being occasioned by the almost complete failure of the cod work at the Woods Hole (Mass.) station. The work with this species at the Gloucester (Mass.) station assumed larger proportions than ever before in its history.

BOOTHBAY HARBOR (ME.) STATION

[E. E. HAHN, Superintendent]

In the course of the fall and winter every effort was made to secure cod and haddock eggs for stocking the hatchery at this point but without success. No schools of spawning fish of either of these species could be located in waters along the Maine coast, and the alewives passing by on their way to spawning grounds in fresh waters were immature.

Unusual success was attained, however, in the work with the winter flounder, the egg collections and output of fry of that species being among the largest in the station's history. Seventy-eight fyke nets for the capture of a brood stock were set in Casco, Linekins, and Johns Bays, the same fields that have been resorted to in past years. While heavy ice was encountered in the early part of the season, and a few of the nets were damaged by it, the results in general were very gratifying. Large spawners in goodly numbers were transferred to the hatchery and cared for in the retaining tables until they had cast their spawn, the total for the season aggregating in excess of 6,000.

Spawning began on March 14, and the collections gradually increased to the point where 100,000,000 eggs were taken in a single day. They declined after that time, but there were many days when the daily receipts ran from 30,000,000, to 80,000,000. The last lot of eggs was taken on May 8. The total collections amounted to 1,627,025,000 eggs of much better than the average quality, and in the incubation and distribution of the product merely nominal losses were sustained.

The steamer *Gannet* and its crew rendered valuable assistance in connection with the work, transporting and operating the fyke nets, carrying the brood fish to the station, and liberating the fry on the spawning grounds.

GLOUCESTER (MASS.) STATION

[C. G. CORLISS, Superintendent]

The active fish-cultural work of the year at the Gloucester station began on November 11, with the collection of pollock eggs from the commercial fisheries. The work was conducted under practically the same adverse conditions that prevailed in the past two years. Not only were fewer and smaller boats engaged in pollock fishing, but with one or two exceptions they were equipped with old, inefficient nets. The prevailing low market prices had much to do with the general lack of interest on the part of the fishermen. The earliest eggs came from Cape Ann, but the poor results attained in that region soon caused the fishermen to shift to territory in the vicinity of Plymouth, Mass., and most of the eggs obtained for the hatchery were secured here. The daily receipts from the Plymouth field were large until about the first week in December, when the transfer of many of the boats to the cod work caused them to drop off sharply. By the close of the season on January 31 eggs to the number of 399,680,000 had been secured. All of these were incubated in the hatchery, and the resulting fry were planted in the coastal waters of Massachusetts.

Collections of cod eggs extended over the entire fishing season for that species—from early November to the middle of May—and the results in eggs secured and fry developed were far in excess of any previous cod records at this station. During the first three months of the fishing season the egg collections were uniformly light, but as soon as the pollock work was closed and additional employees were available for cod-egg collections there was a large increase in the daily take. Eggs were secured on 109 days, and the total collection, between November 11 and May 13, amounted to 802,110,000. Of these only 516,680,000 were incubated, the remainder being planted on the fishing grounds immediately after being fertilized.

The propagation of haddock was somewhat curtailed as compared with other years, owing to a prevailing scarcity of fish throughout the season. The run appeared later than usual, and 237,770,000 eggs were taken between March 19 and May 14. As was the case in the cod work, the low water density in the hatchery at the time the eggs were secured necessitated the planting of large numbers on the spawning grounds as fertilized eggs.

In the latter part of February work with the winter flounder was taken up and prosecuted in connection with cod and haddock operations. Brood fish of this species to the number of 288 were captured in fyke nets set in Gloucester Harbor, and from them 102,740,000 eggs were obtained, the spawning season extending from March 19 to April 25. A noteworthy feature of this work was the unusually large size of the brood fish. One of them—the largest ever handled at the Gloucester station—measured 8¼ inches in width, weighed 5¼ pounds, and yielded 2,144,000 eggs.

WOODS HOLE (MASS.) STATION

[W. H. Thomas, Superintendent]

The efforts made to propagate cod at this station were almost a complete failure. Owing to the unseasonably mild water temperatures, which prevailed throughout the fall and early winter in all coastal waters of the region, no schools of cod were in evidence either at the traps at Narragansett Pier, upon which the station is dependent for its brood stock, or in Cape Cod Bay, where eggs of this species were plentiful last year. No results whatever were obtainable from the fishing traps, which were in continuous operation up to the end of November. Late in October the steamer *Phalarope* and a force of spawn takers proceeded to the eastern entrance of Cape Cod Canal to establish headquarters for the collection of spawn, the indications at that time being that the capture of cod in this field would at least equal the catch of the previous winter. Men were also sent to the usual cod-fishing centers along the coasts of Connecticut and Rhode Island. In all fields visited it was found that water temperature conditions were abnormal to the extent of excluding the migration of spawning cod in any of the coastal waters within reach of the station. The total results of the season's efforts were 4,779,000 eggs from fields that had yielded nearly 670,000,000 last year. Incidental to the search for cod spawn a few pollock eggs were taken in Cape Cod Bay and incubated.

In advance of the spawning season quite extensive arrangements were made for the propagation of winter flounder, the prevailing mild weather indicating that brood fish in large numbers would be available. The fyke nets set at Waquoit, Mass., were successfully operated early in the season, but toward the last of February very nearly normal weather set in, and the formation of ice on the fishing grounds made it difficult to handle the nets. The work in this field was prosecuted from early in January to March 10, and a sufficient number of brood fish were secured to yield upward of 507,000,000 eggs. The search was also extended to fields formerly occupied in the vicinity of Wickford, R. I., and Block Island and Noank, Conn., and from all points occupied a total of 604,159,000 eggs of good quality were obtained.

During the spring spawning period a persistent effort was made to secure eggs of the mackerel, scup, and sea bass. No success was attained, however, owing to the difficulty of finding ripe fish of both sexes at the same time. On the single occasion when mackerel spawn might have been taken and fertilized some delay was experienced in starting the engine of the motor boat, and the traps had all been lifted prior to the arrival of the spawn takers. On this particular morning about 60 barrels of large mackerel were taken in the traps.

ANADROMOUS FISHES OF THE ATLANTIC COAST

The fish-cultural work of the three stations under this head was concerned with the Atlantic salmon, the shad, river herring, and the humpback salmon. The total output of these species in round numbers during the year was 110,887,000, a decrease of approximately 56,000,000 as compared with that of the preceding year. The reduction in this branch of the work was due principally to the unfavorable weather conditions encountered during the shad spawning season on the Potomac River and in the Albemarle Sound region.

Owing to the presence of polluted water on the spawning grounds of the striped bass in the Roanoke River near Weldon, N. C., the bureau's hatchery for the propagation of that species was not opened during the year.

SHAD

Bryans Point (Md.) substation.—The most important work of this station is that addressed to the propagation of shad, and for a long period of years such work was almost uniformly successful. Notwithstanding the aggressive commercial fishing to which it has been subjected, the run of shad in this river is noteworthy in not having suffered diminution to the extent that has occurred in all other streams resorted to by this species. The maintenance of the shad run in the Potomac, in contrast to the entire disappearance of the species in many streams and greatly reduced runs in all others, has frequently been cited as a proof of the efficacy of artificial propagation in regions where the environment is reasonably favorable.

The run of shad in the Potomac River during the fiscal year 1924 proved to be almost an entire failure, both from the viewpoint of the fisheries and fish culture. Undoubtedly this unfortunate state of affairs was brought about by truly remarkable conditions. The first unfavorable weather affecting the run of fish was on March 10, when a heavy snowstorm occurred, accompanied by a strong northeast gale and followed by a heavy rain. A second severe snowfall was experienced on April 1, and on May 11 the river was subjected to one of the heaviest freshets recorded. It thus transpired that throughout the natural spawning season a continuous series of unfavorable conditions prevailed—unseasonably low water temperatures from the late snowstorms, and flood stages accompanied by extreme turbidity of the water. The same conditions extended throughout the entire length of the river.

The first shad of the season, in spawning condition, were taken on April 23, and small daily collections of eggs were obtained from that time to May 11, on which date the flood effectually put an end to further fishing. Eggs to the number of 8,597,000 were taken during the short collecting season. Of this number some 94 per cent were hatched, producing 7,953,000 fry of good quality. All of these were distributed on the principal natural spawning areas in the river.

SHAD AND RIVER HERRING. EDENTON (N. C.) STATION

[WM. S. VINCENT, Superintendent]

The work of this station was concerned with two species of commercial importance—the shad and the river herring—and it was extended during the year on a small scale to include the yellow perch, a species for which there is a strong demand and which supports a commercial fishery of some importance.

As was the case on the Potomac River, the weather in Albemarle Sound during the spring spawning season was most unpropitious, and its effect was made evident in the small numbers of fish and eggs taken. With the discontinuance of the former practice of granting permits to a limited number of fishermen to use gill nets on the natural spawning grounds of the shad, the bureau's only source of supply was the Capehart Beach fishery, which resumed operations last spring after a lapse of several years' duration. Operations here were conducted on a much smaller scale and with a much shorter seine than in past years, the total capture of shad for the season approximating 12,000 fish. Ripe eggs were taken from April 17 to May 8, the season's collections aggregating 7,855,000. These were incubated with a loss of only 10 per cent, and the resulting fry were planted in suitable places on the natural spawning grounds.

As the run of herring occurs simultaneously with that of the shad, the fishing operations suffered proportionately from adverse climatic conditions. Between April 15 and May 11, 222,000,000 eggs were obtained from herring taken for commercial purposes, this figure showing a shortage of about 30 per cent in the collections as compared with last year. The eggs were not equal in quality to those of the shad, only 50 per cent of them producing fry.

Egg collections of the yellow perch were taken up in a tentative way during the spring. Some 300 adult fish were acquired by purchase from local fishermen and held in confinement until the spawn ripened, some of them being retained in a pond having a natural earth bottom, while others were placed in a wooden crate immersed in the water of a small concrete pond. In each case the fish were allowed to spawn naturally and all of the eggs proved to be of high quality. Artificial manipulation of the fish as a means of obtaining eggs was also successfully tried. For this purpose a station employee accompanied the fishermen lifting the pound nets used for the capture of fish for the market. Because of the very small number of fish containing ripe eggs this undertaking did not prove profitable, though the small number taken were readily fertilized and incubated with as little loss as on those deposited naturally. A total of 5,460,000 eggs was secured.

ATLANTIC AND HUMPBACK SALMONS. CRAIG BROOK (ME.) STATION

[J. D. DE ROCHER, Superintendent]

Because of the persistent refusal of the salmon fishermen of the Penobscot River to render reasonable assistance to the bureau in the prosecution of its Atlantic salmon work, no attempt was made to secure brood fish of that species during the fiscal year 1924. The work was therefore confined to the incubation of some 500,000 eggs received from the Canadian Government in exchange for an equal number of eggs of other species of the Salmonidæ. Upward of 95 per cent of these eggs produced fry, which were distributed in the Naraguagus, Dennys, Piscataquis, and Penobscot Rivers, all in the State of Maine.

Of interest in connection with the fish-cultural work at this point is the continued presence in the Dennys and Pembroke Rivers every second year of a run of spawning humpback salmon. During the month of September employees of the Craig Brook station secured approximately 600,000 eggs from these fish, and the resulting fry were returned to the streams from which the eggs were derived. The losses during incubation were rather heavy, amounting to nearly 35 per cent of the original stock.

FISHES OF MINOR INTERIOR WATERS

The more important fishes propagated at the bureau's stations for the stocking of interior waters are the rainbow, black-spotted, and brook trouts, landlocked salmon, the crappies, the black basses, catfish, rock bass, and sunfish. The extensive fishing being done in the public waters of the country at the present time is making it exceedingly difficult to supply the ever-increasing demands for the game fishes. This applies especially to the brook trout and to practically all of the pondfishes, but more particularly to the large-mouth and small-mouth black bass. In the case of the brook trout the output is necessarily limited owing to the fact that a large proportion of the eggs are purchased from commercial fish culturists and in many instances are greatly inferior to those derived from wild fish. In the production of the pondfishes the work is frequently handicapped by unfavorable weather, and it is necessarily limited by the small pond areas available for carrying on the work.

The cooperative relations that have been developed within the past few years between the bureau and fish and game organizations in practically all parts of the country have done much to improve conditions pertaining to fish life in public waters. Many of these organizations have been instrumental in having laws passed for the better protection of wild life in their respective States and have brought about an increased respect for such laws on the part of the general public.

ROCKY MOUNTAIN TROUT STATIONS

The activities of this group, comprising five main stations and a number of substations and field collecting auxiliaries, are confined to the States of South Dakota, Colorado, Wyoming, Utah, and Montana. They were engaged during the year in the cultivation of brook, rainbow, black-spotted, and Loch Leven trouts, and to a lesser degree in the propagation of the Montana grayling.

BOZEMAN (MONT.) STATION AND SUBSTATIONS

[W. T. THOMPSON, Superintendent]

The outcome of the year's fish-cultural work at Bozeman station and its auxiliaries was generally satisfactory. The newly opened field for the collection of Loch Leven spawn proved a prolific one, and through the exchange of surplus eggs of this species for those of the brook trout a very large season's work in the propagation of brook trout was made possible. An exchange of Loch Leven trout eggs for grayling eggs was made with the Montana Department of Fish and Game, the grayling being used to stock the waters of Glacier Park.

Bozeman (Mont.) station.—At the opening of the fiscal year the ponds at the Bozeman station contained 482,450 brook trout and 52 000 steelhead salmon fingerlings; also 211,000 rainbow-trout fry. Early in July a cloudburst in Bridger Creek flooded the ponds in which this stock was being held, causing a loss of approximately 120,000 brook trout and 36,500 rainbow trout. Before the distributions could be made the stock of brook trout was still further reduced by abnormally high water temperatures, the mortality from this cause exceeding 88,000.

As a result of the spawning of the station brood stock in the fall 58,000 brook-trout eggs and 38,000 rainbow-trout eggs were realized. Forty-two thousand rainbow-trout eggs were also collected from wild fish in the course of an investigation of the field at Mitchener Springs, Mont., and 500,550 eyed eggs of this species were transferred to the station from its Meadow Creek auxiliary early in June, 1924. Of this latter consignment 60,000 were reshipped to the Neosho (Mo.) station, 40,000 were planted in Sawtooth Lake in northern Wyoming, and the fry resulting from the remainder were on hand at the close of the fiscal year.

Shipments of eyed brook-trout eggs, in return for spawn of the Loch Leven trout, was received as follows: 485,000 from the Springville (Utah) station; 285,000 from the Leadville (Colo.) station; 608,000 from the Minnesota Game and Fish Department; 291,000 from the Canadian Fisheries Department.

Approximately 1,500,000 black-spotted-trout eggs were transferred to the Bozeman hatchery from the Yellowstone Park field in July, 1923. These suffered heavy losses during the incubation period, and many of the resulting fry succumbed owing to their inability to take food. Eyed eggs of this species to the number of 958,100 were received in June, 1924, and were successfully hatched. The station also received during the year 50,000 eyed lake-trout eggs from the Charlevoix (Mich.) substation and 650,000 Loch Leven trout eggs from the Madison Valley field. The output of the various species handled is shown in the general distribution statement on page 432.

Meadow Creek (Mont.) substation.—An outstanding feature of the work in this field was the remarkable success attained in the collection of Loch Leven trout eggs. An investigation of the field during the late summer having disclosed a very promising outlook, three traps were installed in Odell Creek late in September, and spawning trout in considerable numbers were captured almost immediately. Between October 11 and November 30, 7,700,000 excellent eggs were secured, the average number per fish being about 1,250. On reaching the eyed stage 6,288,000 were shipped to other hatcheries of the bureau and to various State fish commissions and associations, in many cases being exchanged for eyed brook-trout eggs.

The rainbow-trout spawning season opened April 4, about two weeks earlier than usual, and eggs were taken up to May 22, the total amounting to 2,737,970. The eggs were of excellent quality, and merely nominal losses were sustained during the incubation period. Very high water stages prevailed throughout the spawning season. At one time the water was over the tops of the racks, flooding the surrounding bottom land and releasing about 1,500 of the brood fish that were being held for the ripening of their eggs.

Incidental to the work with the rainbow trout, a few black-spotted trout were taken in the traps, and from them 6,000 eggs were collected, fertilized, and hatched. On June 3 a consignment of 3,000,000 green grayling eggs of fine quality was transferred to the Meadow Creek substation by the Montana Department of Fish and Game, with the view of planting the resulting fry in Odell and Meadow Creeks. This work was completed and the station closed for the season on June 25.

Glacier National Park (*Mont.*) *substation.*—There were on hand at the Glacier Park hatchery at the opening of the fiscal year 85,000 eggs and 70,000 fry of the rainbow trout. These were carried to the No. 1 fingerling stage and then distributed, the entire losses on eggs and fry being less than 3½ per cent of the original stock.

Of a lot of 1,000,000 eyed black-spotted trout eggs received in July, 1923, from the Yellowstone Park field 329,000 were planted in the eyed stage in some of the more inaccessible waters of Glacier Park. The remainder were incubated and liberated as fingerlings in August. All of the fry resulting from grayling eggs furnished by the State of Montana were also used for stocking the waters of this park. The Glacier Park Service rendered very efficient aid in connection with the distributions from this hatchery.

LEADVILLE (COLO.) STATION

[C. H. VAN ATTA, Superintendent]

In accordance with the usual practice this station operated several privately owned lakes and reservoirs, and with the exception of one lot of commercial eggs its entire stock of brook-trout spawn was obtained in this way. During October and November employees detailed from the Leadville station collected eggs of this species at Engelbrecht, Turquoise, Musgrove, Marma, Wurts, and Evergreen Lakes, securing in the aggregate 5,946,000, or 744,000 less than were obtained last season. At Engelbrecht Lakes, where fishing is allowed only to a limited extent, the yield was noticeably increased, and at Evergreen Lakes—situated on the station reservation—more eggs were taken than for several years past. At all other points there was a considerable decrease, especially at Turquoise Lake, where the collections were smaller by 800,000 than last year. The shortage at these lakes is attributed in some degree to excessive fishing but weather conditions also figured largely in the results at Turquoise, abnormally high water stages and the formation of ice on the lake early in the spawning season materially curtailing the output. The field collections of the species were augmented to the extent of 111,000 eggs purchased from a dealer in Colorado.

During the progress of the brook-trout spawning season 71,700 Loch Leven trout eggs were collected at Turquoise Lake, and 407,500 eyed eggs of this species were transferred from the Meadow Creek field in exchange for an equal number of brook-trout eggs. In the last half of May 20,300 eggs of the rainbow trout were secured in one of the Evergreen Lakes. The station also handled 991,000 black-spotted trout eggs transferred from the Yellowstone Park, 144,400 lake-trout eggs from the Charlevoix (Mich.) hatchery, and 24,900 steelhead eggs from one of the bureau's substations in the State of Washington. The eyed eggs, fry, and fingerling fish produced and distributed from this stock of spawn are shown in the general distribution statement.

YELLOWSTONE NATIONAL PARK (WYO.) SUBSTATION

[C. F. CULLER, in charge]

Fish-cultural operations in this field were directed by the district supervisor, assisted by a force of trained men drawn from several of the permanently established stations. Of the 26,776,000 black-spotted trout eggs collected in July, 1923, approximately 50 per cent were incubated in the bureau's hatchery located near the Lake Hotel, and the resulting fry were liberated in park waters. The remaining 50 per cent were supplied to State and National hatcheries in the Rocky Mountain regions.

The most prolific egg-collecting fields are various streams located along the eastern shores of Yellowstone Lake, the principal ones being Pelican, Cub, Columbine, Clear, and Chipmunk Creeks.

On May 21, 1924, the operating crew landed at the lake hatchery and at once proceeded to install racks and traps in suitable streams on the west side, among them being Hatchery, Bridge, Arnica, and Thumb Creeks. Experience has shown that the fish start to run as soon as the ice disappears. After racking the west-side streams work was undertaken on the east side of the lake. A very satisfactory collection of eggs was made in Pelican Creek. These eggs were of better quality than those obtained there in recent years. The eggs secured in the Soda Butte field were transferred to the lake hatchery, and the resulting fry were planted in streams emptying into Yellowstone Lake. The fish in Soda Butte appear to be much larger than those in the lake, and it is purposed to introduce them into the lake in an effort to improve the stock.

Excellent cooperation in the work was extended by the superintendent of Yellowstone Park, while various employees of the National Park Service rendered valuable assistance in the transportation of fish and eggs to the more inaccessible waters of the reservation. It is the bureau's policy to plant both fish and eggs near the sources of many of the streams tributary to the lake at points not readily accessible to the public. The egg collections in this field during the fiscal year amounted to 39,253,500, while the eggs obtained during the season of 1924, from June 1 to July 30, aggregated 32,000,000.

The old launch *No. 8* having deteriorated to such an extent that it was no longer serviceable, a new 32-foot launch, built at Sandusky, Ohio, to meet the conditions on Lake Erie, was purchased. This boat is equipped with a 20-horsepower engine. It was delivered at the lake about June 1, 1924, and will aid greatly in making egg collections and in transporting fish to the more distant parts of the lake.

SARATOGA (WYO.) STATION

[O. N. BALDWIN, Superintendent]

At the beginning of the fiscal year this station was carrying 393,000 young brook trout from the hatch of the preceding year. These were distributed in the Nos. 2 and 2½ fingerling stages, some of them being supplied to applicants and the remainder planted in the national forests of the region, employees of the Forest Service cooperating in the work. In addition to the brook-trout eggs secured during the fall from the station brood stock, amounting to 376,000, eggs were collected between October 12 and November 15 from wild fish taken in Big Creek Lakes and transported by truck and pack horses to the station for incubation. Upward of 400,000 were thus obtained and hatched with a total loss of only 8 per cent. All of the fry resulting from this stock were distributed with the exception of 318,000, which were on hand at the close of the fiscal year.

The Big Creek Lakes property was formerly under the control of the Big Horn Cattle and Improvement Co., but suit to cancel its rights thereto was instituted three years ago by the Government. A decision having been rendered in favor of the Government, all fishing privileges were vested in the Forest Service, and as that service desires the development of the lakes from a fish-cultural standpoint, the bureau has undertaken to build up a field collecting station in that region by making annual plants of fish in the lakes.

During April and May operations connected with the collection of rainbow-trout eggs were in progress in the Sage Creek, Lost Creek, and Canon Creek fields. The season's total—aggregating 953,450—shows somewhat reduced results as compared with previous collections. All eggs obtained were of superior quality, however, owing to the more experienced help available for the work and also to the improved water conditions, the amount of sediment carried in the supply being unusually small. The falling off in numbers is attributed in part to the flooding of the creeks consequent to the rapid melting of the heavy snows of March and early April, permitting many of the brood fish to escape. The brood fish at the station furnished 26,000 additional eggs of this species. At the close of the year a fair proportion of the fry produced from the field collections were being reared, with the view of returning them to their native waters as fingerlings during the late summer months.

From the station brood stock of Loch Leven trout 18,000 eggs were obtained, and 403,000 eyed eggs of this species were transferred from the collections made in the Meadow Creek (Mont.) field. On account of the crowded condition of the Saratoga hatchery at the time of receipt, 100,000 of these eggs were turned over to the State hatchery at Laramie, Wyo., to be incubated for the Forest Service. Five hundred thousand eyed black-spotted-trout eggs received from the Yellowstone Park field were hatched with practically no loss, and the resulting fry and fingerlings were used to stock streams at a high altitude in various national forests.

The mountain streams in the vicinity of Pinedale, Wyo., were investigated during September with the view of finding a suitable site for the collection of black-spotted-trout eggs. A promising field was located, but as no funds were available for the purpose it was impossible to do anything toward its development during the year.

SPEARFISH (S. DAK.) STATION

[D. C. BOOTH, Superintendent]

Fish-cultural activities at this station were chiefly concerned in the propagation and distribution of the brook, Loch Leven, and rainbow trouts, and the steelhead salmon, the aggregate output of fish of these species for the year amounting in round numbers to 1,460,000. Aside from the work prosecuted at the main station and its Sand Creek auxiliary, located near Beulah, Wyo., the Spearfish station assisted in the black-spotted-trout operations in the Yellowstone Park by furnishing the services of two of its regular personnel during the egg-collecting and eying period in that field. Some work was also accomplished in the way of pond construction, and, to overcome a considerable wastage from the new concrete storage reservoir, a concrete bottom was laid over a large portion of its area.

Approximately 180,000 brook and Loch Leven trout eggs were collected during the fall from the station brood stock, and 110,500 additional wild eggs of these species were secured in the Sand Creek field. This stream constitutes the only available source of supply in the region for eggs from wild trout, and were it not for the fact that it is being heavily fished every year by tourists and automobile parties it could soon be built up to the point where it would form a valuable adjunct to the work of the Spearfish station. This stock was increased by the transfer of 375,000 brook-trout eggs from the Springville (Utah) station and 1,005,000 Loch Leven trout eggs from the Madison Valley (Mont.) field station.

Between January 29 and March 20 the brood rainbow trout carried in the station ponds yielded approximately 56,000 eggs, and later in the spring a consignment of about 55,000 steelhead eggs was forwarded to the station from a hatchery operated by the Oregon Fish Commission. Aside from the distributions made during the year, considerable numbers of young trout of the various species handled were reserved to supplement the station brood stock.

SPRINGVILLE (UTAH) STATION

[CLAUDIUS WALLICH, Superintendent]

In pursuance of an agreement entered into with the fisheries authorities of Utah, an employee of the bureau's Springville station was detailed during October to make collections of brook-trout eggs at Fish Lake in conjunction with employees of the State. This work extended from October 18 to November 25, and during its progress approximately 7,000,000 eggs of good quality were secured, of which 2,500,000 were allotted as the bureau's share. The spawning period could hardly be said to have closed when operations ceased, but the lateness of the season made it appear advisable to discontinue the work and transfer the collections to the home station before the roads were made impassable by snow. The great abundance of fingerling trout noted all along the shores of the lake in the course of spawn-taking furnishes good evidence that the supply of brook trout in this body of water is being well maintained.

From the eggs derived from this field, comprising the station's entire stock of this species, 1,475,000 were shipped in the eyed stage to various stations of the bureau and 520,000 fry were produced, the proceeds being equivalent to an 80 per cent hatch. The alevins were strong and continued to thrive until late in February, when the hatchery water appeared to be filled with finely divided vegetable matter, the water at the intake at this period being at a low level. In a short time the gills of many of the young fish became so congested that a heavy loss ensued. On being removed to another environment a considerable percentage of the affected fish recovered.

Quite extensive improvements were made during the year with the view of bettering the condition of the brood rainbow trout. Long parallel dikes were constructed down the center of two of the large earth ponds to confine all available water in an 18-foot channel, this arrangement providing a good current of water of a moderate temperature at all times. On the completion of the repairs the entire stock of 2,300 adult rainbow trout was transferred to the ponds, and a great improvement in their physical condition was soon noted. These fish spawned between December 15 and March 10, yielding 1,121,700 eggs, of which 878,180, or 78 per cent, were hatched. The loss of fry was light up to the time the stock was transferred to the concrete pond system, such action being necessitated through lack of space elsewhere. It was observed that the fry placed in the ponds having the first use of the water did very well, but the losses in the ponds fourth and fifth in line was extremely heavy. There was no lack of water, but a strong current was found to sweep the fish against the screens, where they soon succumbed. The experience indicates that the use of less water in the first place would have given better results. In this connection it is believed that a series of tanks installed along the south side of the concrete pond system, where water is abundant, would be a great aid to the station in carrying its needed stock of fingerling fish. The net result of the operations was the distribution of upward of 211,000 fingerlings Nos. 2 and 2½ and the retention of 60,000 fine fingerlings for the work of the succeeding year.

During April and May egg collections of the rainbow trout were undertaken in the Fish Lake field in cooperation with the State, and at the same time extensive plants of fish were made therein both from the Springville station and the State hatchery, the truck employed to bring out eggs for shipment returning each time with a load of fish for the lake. The spawning season extended from April 22 to May 24, the bureau receiving 905,000 as its share of the 5,407,000 secured. Quite extensive losses occurred in the egg and fry stages, and at the close of the year the proceeds of this work were 507,000 fry in the early feeding stage.

In the course of the year efforts were directed toward the establishment of additional field stations for the collection of rainbow-trout eggs in the Fish Lake and Panguitch Lake fields. In this investigation the cooperation of the United States Forest Service was enlisted and favorable sites were found, the one at Fish Lake being within the forest reserve, while the one at Panguitch Lake is on private property. It is probable that egg collections in both these fields will be undertaken in the near future in conjunction with the State of Utah.

From 50,000 black-spotted-trout eggs received from the bureau's station in the Yellowstone Park during the summer of 1923, 25,000 fingerlings No. 2 were produced and distributed to applicants. In an attempt to fill additional demands for this species, egg collections in cooperation with the State were undertaken in the Strawberry Reservoir field early in June, 1924. As a result of this work the station acquired 600,000 eggs, but their number was so reduced by losses that only 165,000 survived to the eyed stage.

NEW ENGLAND TROUT AND SALMON STATIONS

Under this head are included the four stations located in the States of Massachusetts, Maine, Vermont, and New Hampshire, together with several substations. The fish-cultural work of these stations is addressed primarily to the propagation of trout. Owing to climatic and other adverse conditions the output of the group was considerably reduced as compared with that of the preceding year.

BERKSHIRE (MASS.) STATION

[G. R. Hoffses, Superintendent]

Though the fish-cultural work of this station was concerned with three species of fish, its output for the fiscal year consisted of brook trout and rainbow trout only. Between October 16 and December 19, 144,280 brook-trout eggs were collected from brood fish in the station ponds and 102,000 eyed eggs were acquired by purchase from a commercial hatchery in Massachusetts. The station eggs were taken from 245 brood fish, 99 of which were only 2 years old. The balance were of various ages, but the majority of them were past their prime. The 2-year-old fish produced an average of about 300 eggs per fish, while the average from the others amounted to less than 800. As might be anticipated, the eggs were not of high quality and the losses during incubation, and subsequently on fry and fingerling fish, were greater than could reasonably be expected from eggs resulting from more nearly normal parents. Notwithstanding these facts, however, a fair percentage of fingerlings Nos. 1½ and 2 was realized.

The commercial eggs were of exceptionally good quality when received, and they remained in good condition throughout the incubation period. The losses sustained in the fry and fingerling stages were also negligible. A number of young fish from this lot of eggs is being reserved to replenish the brood stock.

Twenty-five thousand rainbow-trout eggs, received in May from the Michigan State hatchery at Paris, Mich., were also of excellent quality, and from them a high percentage of fingerling fish was produced. One of the most gratifying features of the year's work was the entire absence of disease, which has so frequently become epidemic among the young trout at this station.

Fifty-four adult small-mouth black bass, received in May from the Cape Vincent (N. Y.) station, were at once distributed in ponds previously prepared for them. Three of these fish died almost immediately after being installed, apparently from injuries received during transportation. Within a few days there were indications of spawning, the fish working on two of the artificial nests provided and on a number of spots of their own selection. However, no eggs had been deposited at the close of the year, though the fish at the time appeared to be in excellent condition. It is impossible to account for this failure to spawn. Climatic conditions appeared to be favorable, and three dead fish proved on opening to be females with eggs well along toward maturity. It may be that the fish were not properly segregated as to sex when placed in the ponds.

CRAIG BROOK (ME.) STATION AND SUBSTATIONS

[J. D. DE ROCHER, Superintendent]

Aside from the work with the Atlantic and humpback salmons, a review of which may be found on page 407 under the heading "Anadromous fishes of Atlantic rivers," the operations at this group, including the main station at Craig Brook, near the town of East Orland, Me., and its substations at Grand Lake Stream and Green Lake, Me., involved the landlocked salmon, brook trout, rainbow trout, lake trout, and smelt. The work at all points met with a fair degree of success, and there was a noteworthy increase in the collection of eggs of the valuable landlocked salmon as compared with the preceding year.

During November a pound net set in Toddy Pond, near the station, was the means of capturing 74 adult landlocked salmon, from which 34,000 eggs were secured. The bureau has for several seasons past released limited numbers of landlocked salmon fry and fingerlings in this body of water, and the results of the tentative collections, undertaken for the first time during this year, give promise of considerable expansion in the future. In addition to the eggs collected, the State of Maine transferred from its collections at Caribou and Oquossoc, Me., approximately 250,000 eyed eggs and about the same number were transferred from the Grand Lake Stream substation. Of these 190,000 were reshipped to other stations of the bureau, State fish hatcheries, and other points to meet the distribution requirements. The remainder were incubated, the resulting fry entering into the general distribution from the station or remaining on hand at the close of the year.

Of this species 14,000 eggs were obtained from wild fish in Craig Pond, another body of water conveniently located and which the bureau is endeavoring to develop as a source of egg supply. About 1,268,000 eyed brook-trout eggs were acquired by purchase from commercial breeders, and 50,000 of this lot were reshipped to the substation at Grand Lake Stream. The others were successfully incubated, and the young fish resulting from them entered into the general distributions.

To meet distribution requirements consignments of eggs of the rainbow trout and lake trout were received by transfer—the former from the Wytheville (Va.) station and the latter from the Cape Vincent (N. Y.) station. The rainbow-trout eggs proved to be an inferior lot and suffered heavy mortality in the course of incubation.

Some repairs and alterations were made to the old pond system during the year, with the view of providing facilities for the production of larger numbers of fingerling fish.

Green Lake (Me.) substation.—For the past two years the fish-cultural work at this point has been confined to the propagation of landlocked salmon and smelt. Pound nets were placed in the lake at the mouth of the principal spawning stream early in November for the capture of a brood stock of landlocked salmon. The fish thus secured were of a considerably larger size than those similarly taken in previous years. The 280,000 eggs obtained from them produced 258,200 advanced fry for distribution. In pursuance of a recently adopted policy all of these fry were returned to Green Lake waters.

Between March 25 and April 18 smelt eggs numbering 18,000,000 were secured from adult fish taken in the traps installed in Great Brook. The season proved one of the most successful ever experienced at this point in smelt propagation, both as regards the number of eggs handled and their quality.

Every year there are two distinct runs of spawning smelt in streams tributary to Green Lake, the principal distinguishing feature between them being the size. The fish are locally known as large smelt and small smelt. Fish-cultural work in 1924 was concerned with the larger variety, the spawning season of which occurs in March and April, the actual time varying somewhat with climatic conditions. When the run of the smaller variety occurred several weeks later Great Brook was at flood stage and the water carried so much silt and drift that the efforts to collect eggs were fruitless.

Grand Lake Stream (*Me.*) *substation.*—The results of the landlocked salmon work at this point were more successful than for a number of years past. During the period extending from October 22 to November 20, 844,000 eggs were taken, this number representing the spawning of 444 female and 557 male fish, which were taken in traps set in Grand Lake Stream. These adult fish ran considerably larger than usual, their average weight being 4 pounds. The work at Dobsis Lake resulted in the taking of 140,000 eggs from the 96 female fish captured. Both lots of eggs of this species were of excellent quality and from them a good percentage of fry was produced. Fully 75 per cent of the eggs were developed at the Grand Lake Stream hatchery for replenishing local waters. The remainder, some 212,000, were shipped in the eyed stage to the Craig Brook station to meet the distribution requirements in that field.

A peculiarity of the landlocked salmon eggs taken at this substation is the invariably larger size of the eggs secured from Dobsis Lake as compared with those from Grand Lake or Grand Lake Stream, though there is no noticeable difference in the size or vigor of the resulting fry. Of interest also, as a basis of conjecture, is the unusually large number and size of the adult salmon taken in the bureau's traps at Grand Lake Stream during the fall of 1923.

The year's work at the Grand Lake Stream substation included the successful incubation of 50,000 eggs of the brook trout acquired by purchase and the distribution of the product in local waters.

ST. JOHNSBURY (VT.) STATION AND SUBSTATIONS

[A. H. Dinsmore, Superintendent]

The work in this field included that at the main station at St. Johnsbury and at its two substations, one at Holden, Vt., and the other at York Pond, N. H., located in the White Mountain National Forest. During the year the substation at Swanton, Vt., was transferred to the jurisdiction of the Cape Vincent (N. Y.) station, this action seeming appropriate since the work at Swanton is identical in character with the main line of endeavor at Cape Vincent. As in past years, the principal work at St. Johnsbury and Holden has been the incubation of trout eggs and the distribution of the fry. Only such improvement work as was essential to the property was undertaken, the object being to conserve all possible funds for the development of the important trout-rearing project at York Pond.

St. Johnsbury (Vt.) station.—Brook-trout eggs to the number of 883,000 collected in the Darling Pond field were successfully incubated, and the station received of this lot, in return for its work of collection and incubation, approximately 250,000 of the resulting fry for general distribution. The remainder were disposed of to private persons and to the State of Vermont in the interest of the pond owners. Of the brook-trout eggs purchased from commercial dealers some 245,000 were retained and the remainder—about 260,000—were transferred to Holden substation. Brook-trout eggs to the number of 120,000 were also incubated for the Caledonia Forest and Stream Club, and the product was distributed in the public waters of the region by the organization. Such work, which has been practiced for several seasons, has proved very profitable and it extends the service which the bureau is able to render at a minimum of expense. Other similar organizations are asking for this service, and the State commissioner of fish and game has agreed to duplicate all such purchases of eggs intended for the stocking of the public waters of the State. The season's work with the brook trout was highly satisfactory, the losses on both eggs and fry being quite trivial. Lake-trout eggs to the number of 92,000, from collections made at Lake Dunmore, Vt., were incubated at the station and distributed in local waters. The planting of lake-trout fry in certain ponds in northern Vermont has resulted in such marked improvement in the fishing as to fully warrant a continuance of such plants.

Twenty-five thousand landlocked-salmon eggs from the Green Lake (Me.) substation and 50,000 steelhead eggs from the Oregon field were also incubated. Most of the fry from these eggs were sent to the State hatchery at Roxbury, Vt., for rearing, and the remainder entered into the general distributions. A small number of eggs was obtained during April from 330 adult steelhead salmon held at the station. These eggs were of excellent quality and yielded a large percentage of fry. This item is of passing interest, since previous efforts to obtain eggs from steelheads held at this station have always resulted in failure.

Holden (Vt.) substation.—The cooperative work at Lake Dunmore resulted in a collection of 243,600 green lake-trout eggs. These were transferred to the substation on trays, and on attaining the eyed stage 50 per cent of the lot were delivered to the State of Vermont and the remainder were sent to the St. Johnsbury station. Some 50,000 eggs of this species were received from the Charlevoix (Mich.) field and all of the resulting fry were planted in Lake Dunmore. This substation also incubated approximately 260,000 commercial brook-trout eggs during the year for general distribution.

York Pond (N. H.) substation.—The development work which has been in progress at this substation for some time was vigorously pushed during the year. Among the more important items accomplished was the construction of spawning races below the diversion dam. Water is supplied to these races from the spring run along the base of Bear Mountain, to which supply is added the flow from two driven wells. There is also a sufficient amount of seepage water through the bottom of the races to care for a large number of fish even if the regular supply should be cut off by accident or for cleaning purposes. The diversion ditch from Cold Brook to York Pond was enlarged throughout its entire length and the embankment raised where necessary. Fearing a possible interruption of the flow through this ditch during the anchor ice period, fish were not carried in the large artificial pond formed by the diversion of Cold Brook. Some important improvements were made in the hatchery water supply, and a permanent water system for domestic use was installed at the main camp

Some difficulty was experienced in capturing the spawning trout in York Pond. They failed to enter the spawning races, and it became necessary to resort to seining to secure them. About 1,500 females were thus taken. These were small fish and yielded a total of 251,000 eggs in round numbers, an average of about 200 per fish.

Of interest in connection with the work were the results of natural spawning in one of the races. The spawning season—from October 1 to December 22—was unusually extended, and it was considered good practice not to strip all of the smallest fish. Some 600 females, averaging about 4 inches in length, were left in race No. 2 with a suitable number of males, and from time to time it was noted that they were spawning. Fry appeared in the race very early in the spring, and additional fry continued to come out of the gravel until late May. By this time many of the earlier ones had attained a length of 2 inches, indicating the presence of a good supply of natural food. At the close of the year it was estimated that the race contained upward of a thousand varying in size from fry to No. 3 fingerlings. It is known that many fry escaped from the race.

NASHUA (N. H.) STATION

[W. F. HUBBARD, Superintendent]

In the conduct of fish-cultural activities at this station there was no departure from the methods heretofore employed. With the opening of the year the hatchery and ponds were carrying considerable numbers of brook, lake, and rainbow trouts, also limited supplies of small-mouth black bass and landlocked salmon. All of this stock was disposed of during the summer and fall, the distributions extending into October.

The first eggs of the season were taken on November 5 from the brood brook and rainbow trout held in the station ponds. The spawning season of these fishes extended into the second week of January, and the entire collection amounted to 223,300 eggs, about equally divided as to species. During January consignments of brook-trout eggs aggregating 583,000 were received from commercial hatcheries. From the combined stock of eggs of this species 599,276 fry, or 80 per cent of the number in the hatchery, were produced.

On January 17 a consignment of 120,900 rainbow-trout eggs arrived from the Neosho (Mo.) station, and early in March 24,000 landlocked-salmon eggs were transferred from the Craig Brook (Me.) hatchery. The mortality on the former was heavy, the percentage of hatch being only 58, but the losses on the landlocked-salmon eggs were merely normal. The spring distributions were taken up on April 14 and continued to the close of the fiscal year. In the conduct of this work the more distant shipments were made in carload lots, and the station truck was utilized to make deliveries within a reasonable distance of Nashua.

A consignment of 4,000,000 eyed pike-perch eggs was received on May 15 from the Swanton (Vt.) substation. During the incubation of these eggs, and especially at night, when the fry came out faster than at any other time, an attendant was constantly employed in keeping the screens clear to prevent the overflow of the troughs.

An employee detailed to collect small-mouth bass fry in Lake Sunapee for the distribution work observed a considerable number of nests of eggs in the lake in early June, but a large proportion of them was destroyed. The cause of this can not be definitely stated, but the indications were that numbers of brood fish were being caught by anglers. Windy weather greatly interfered with the collections and resulted in the loss of many fry. The most difficult problem is to hold them successfully until they can be shipped. When held in the lake in wire cloth retainers, many die within 24 hours, and no better success has been attained by the use of hatching troughs for the purpose.

Fish-cultural work on an efficient basis is practically an impossibility at the Nashua station, owing to its dilapidated condition. Some of the buildings and most of the equipment, including the subsidiary hatchery, the supply flume leading to it, and the hatching-trough system, are in such an advanced stage of decay that it is considered hazardous for the station to acquire a valuable stock of eggs. In the course of last season's operations the flume had to be propped in several places to hold it in position.

Early in the year the station employees were occupied in completing the repairs undertaken last year on the rearing-pond system. The ponds are now so arranged that the water supply flows throughout the entire series, whereas only two could be supplied as originally constructed. These repairs were essentially of a temporary character, as it will be necessary, before any permanent construction is undertaken, to replace the old plank sides of the entire series of ponds with new material.

COMBINATION TROUT AND POND STATIONS

The stations in this group are located at Erwin, Tenn.; Manchester, Iowa; Neosho, Mo.; White Sulphur Springs, W. Va.; and Wytheville, Va. Various species of trout and such pondfishes as the black basses, crappies, and sunfishes are propagated at this group. As brood fish of the different species are always maintained and fish-cultural work in some of its phases is under way at all times, these stations are a source of attraction to the general public.

ERWIN (TENN.) STATION

[A. G. Keesecker, Superintendent]

Fish-cultural work at this point was addressed to the rainbow trout, brook trout, Loch Leven trout, steelhead salmon, large-mouth black bass, small-mouth black bass, rock bass, and sunfish. The results achieved were generally satisfactory and compare favorably with similar work in past years.

Between October 25 and February 11 the female rainbow trout on hand—approximately 800—yielded 847,800 eggs. There was an unusually heavy loss on the green eggs, only 62½ per cent surviving to the eyed stage. Warm weather during the fall, with high water temperatures, was quite probably a contributing cause of this low percentage of fertility. After the eyed stage no further difficulty was experienced with either the eggs or the resulting fish.

The year's work with the brook trout included the successful incubation of 400,000 eyed eggs—acquired by purchase from commercial breeders in Pennsylvania—and the rearing of the product to the fingerling stage before distributing them. In connection with this branch of fish-cultural work the station handled 100,000 eggs of the Loch Leven trout transferred in the eyed stage from the Bozeman (Mont.) station.

The production of the pond fishes was curtailed to a considerable extent as a result of the flood that occurred during September, 1923, when practically all of the brood fish of both the small-mouth and large-mouth black bass were lost. Some of these were later recaptured and returned to the ponds, and the stock was further augmented by shipments from other points. Nevertheless, there was a shortage of breeders as compared with past years. A rather heavy mortality also occurred among the adult sunfish, the trouble developing after the introduction into the ponds of a lot of fish transferred from one of the Mississippi River stations and continuing after the fish had been segregated.

The repairs and improvements made during the year included a thorough overhauling of the building formerly used as the superintendent's residence. Work on this building consisted of an entirely new foundation of concrete, new sills and floor timbers, new roof, and new plastering. Toilet facilities were also added, and the building thus remodeled provides very comfortable quarters for the fish-culturist. New concrete outlets of modern pattern and new drains were installed in four of the ponds, while the area of two others was considerably increased by further excavating. The material removed in this work was used to level up the bottoms of certain ponds that were deeper than required. A number of galvanized-iron hatching troughs to replace worn-out troughs of wood were set up in the nursery and have proved highly satisfactory.

Of possible interest in connection with the feeding of fish is the use of whole-wheat mush. Being equipped with a small burr mill, the station purchased wheat during the year, ground it, and fed the product to the fish in the shape of mush made in the usual way.

MANCHESTER (IOWA) STATION

[F. E. HARE, Superintendent]

Very satisfactory progress was made in the work at this station during the year. The output of fish and fish eggs was increased over that of the previous year to the extent of 60 per cent, and much was accomplished in the way of permanent improvements to the station property. The results attained are particularly noteworthy in view of the fact that the station was operated under a reduced allotment of funds.

Among the more important items of improvements may be mentioned the erection of a dike of concrete construction along the bank of Dry Run. Although it is dry throughout the greater portion of the year, this run carries a large volume of water in periods of heavy rainfall, and the overflow from this source has in the past caused considerable damage to station property and heavy losses of stock. The new dike was designed to prevent a recurrence of such conditions. A cement foundation wall was also placed under the main hatching room to replace timberwork which had decayed.

The small brood stock of brook trout on hand yielded some 56,000 eyed eggs of fair quality. Unlike the rainbow trout, adult brook trout do not appear suited to the conditions at this station, and the brood fish of this species are quite generally affected with a gill disease which causes heavy mortality. To all appearances the fish were in prime condition last year, but with the approach of the spawning period the usual gill trouble developed. In view of the difficulty experienced it is proposed to discontinue the efforts toward brook-trout culture at Manchester and devote the space heretofore occupied by these fish to increasing the production of rainbow trout. This course seems particularly advisable, since the rainbow trout produce highly satisfactory results, and any surplus eggs of that species in stock may readily be exchanged for brook-trout eggs, many of the commercial trout breeders being ready to take advantage of every opportunity of that kind. Included in the station output were the fry and fingerlings produced from some 606,000 brook-trout eggs, 500,000 being transferred from the Leadville (Colo.) station, while the remainder were purchased from a commercial breeder in Colorado.

The results attained in the propagation of rainbow trout were very gratifying. The egg collections were larger by 200,000 than in the preceding year, and the brood stock has increased in numbers and also in quality. Of the 546,000 eggs obtained 235,000 were shipped in the eyed stage to fill the distribution requirements. From the remainder a sufficient number of fingerlings were produced to honor all applications listed. The output of the year also included limited numbers of such species as the small-mouth black bass, large-mouth black bass, and rock bass. An important factor in connection with the poor showing along this line was the exceptionally unfavorable climatic conditions encountered at the spawning time, particularly as regards the small-mouth bass. The spring was a cold one, with protracted frosts and unseasonably low water temperatures. As a result practically all the eggs of the first spawning were a total loss. In addition to the pondfish produced at the station, several thousand catfish, sunfish, and crappie were diverted to the station ponds from the Mississippi River rescue work during the fall, the object being to have such species available for early distribution the following spring.

NEOSHO (MO.) STATION AND SUBSTATIONS

[FRED. J. FOSTER, Superintendent]

The fish-cultural work in this field was addressed to the rainbow trout, brook trout, large-mouth black bass, small-mouth black bass, rock-bass, bluegill sunfish, crappie, and yellow perch, and the aggregate output of fish and fish eggs for the year amounted to approximately 2,413,000.

The outcome of the year's work, which was marked by an increased production of fish and fish eggs at all points, tends to show the efficiency of improved methods in the handling of brood fish, care of ponds, and in combating the fish diseases which have been prevalent at the Neosho station for a long period.

Neosho (Mo.) station.—During a very protracted spawning season of the rainbow trout, extending from November 12 to January 23, slightly more than 1,000,000 eggs were obtained from the 1,280 2-year-old and 3-year-old female fish on hand. The usual low percentage of fertility was apparent among the eggs, although there was an improvement along this line amounting to 10 per cent over last season's egg collections, very nearly 64 per cent of the eggs taken producing fry.

There was an increased amount of disease among the fingerling trout, the most serious trouble being diagnosed as crystals in the kidneys, a condition which the superintendent believes to be due to an inherited predisposition. During May an epidemic of gyrodactylus was readily checked by dipping the affected fishes in a cider-vinegar solution. Later in the season ichthyophthirius also became mildly epidemic but was soon eliminated by increasing the flow of water and lowering its level, thereby increasing the current throughout the infected ponds. To gain some further knowledge of the cause of the disease diagnosed as crystals in the kidneys and a possible remedy therefor, it is purposed during the next few years to discard all brood fish after their first spawning. This policy will at least have the advantage of providing a larger number of adult fish for stocking local waters, and quite possibly it may result in gaining some information of practical value to fish culture.

The principal articles of diet for the fish during the year were fresh meats, largely beef heart, though considerable quantities of hog heart and sheep liver were also used. Clabbered milk in small quantities was employed occasionally to vary the diet and as a corrective measure in digestive disorders. The station superintendent expresses faith in the value of the milk in this connection.

No effort was made to obtain rainbow-trout eggs from the Roaring River field station during the year. After carefully noting the conditions at this point for four months prior to the spawning season it appeared certain that the field could not be advantageously worked. This decision was later substantiated by the low yield of fertile eggs obtained by the owner of the plant, the percentage being less than 10.

The distribution of brook trout was confined to a small number of fish that had been transferred earlier in the year from the Manchester (Iowa) station. From a small number of brood brook trout held in the station ponds during a portion of the year eggs of such inferior quality were obtained that the entire lot, together with the fish, was discarded as being of no value in practical fish culture.

Notwithstanding the fact that the floods occurring during the spawning season of 1923 interfered materially with the fish-cultural work, the number of fingerling bass and other pondfishes produced was over 100 per cent larger than in the previous year and was well above the general station average. One of the main difficulties encountered in the propagation of pondfishes at the Neosho station has been the innumerable parasites with which the brood fish soon become infested. In the late fall of 1923 practically all the brood fish were disposed of and the pond inclosures allowed to remain bare throughout the winter. At the present time all the ponds, with the exception of Nos. 20 and 22, carry new brood fish obtained from Langdon, Kans. As most of the young fish produced from the spawning of 1924 are being held for fall distribution, the exact results of the changes made are not definitely known, but it appears certain that more and better fingerlings will be available for the fall distribution.

Bourbon (Mo.) substation.—It is gratifying to note that the volume of the work at this substation was increased more than 100 per cent during the fiscal year 1924. Rainbow-trout eggs to the number of 588,000 were taken in the course of spawning operations in the fall, from which stock 213,930 eggs in the eyed stage were shipped and 150,000 fingerlings were reared, at a cost to the bureau's appropriation of only $207.49.

During the first four and one-half months of the fiscal year the station was in charge of employees of the Von Hoffman Press, the owners of the property, and with whom the fish-cultural work is being conducted on a cooperative basis. While under such management some difficulty was experienced in handling the fish. In October, after the occurrence of a loss of 8,000 large fingerling trout, the food in use was suspected, but an analysis revealed nothing injurious. The mortality occurred within a 15-hour period, all the fish previously having been in good condition, and those that recovered were apparently in normal health on the second day after the death rate. Later in the same month "popeye" developed among the adult fish held in Spring Lake. An analysis of the water disclosed a supersaturation of nitrogen, a deficiency of oxygen, and the presence of carbon dioxide. There seems little doubt that the condition of the water was responsible for the trouble, as it disappeared promptly after changing the fish to another environment. The abnormal gaseous condition of the water of Blue Spring seems to be present only during late summer and early fall.

Langdon (Kans.) substation.—At the end of the first full year of the bureau's lease of the Kansas property the results of the work may be viewed from different angles. From the number of applicants supplied and the size and condition of the fish produced for distribution the results may be considered highly satisfactory. It has also been the means of materially reducing the numbers of fish diverted from the Mississippi River field to the general distributions; and because of the superior condition of the fish reared in these ponds—as regards their ability to withstand transportation—such distributions have been more than satisfactory to all concerned, and it seems certain that it will eventuate in more and better fish in the waters stocked. Over 100,000 fingerling fish of the various pond species were produced at a cost—including lease of the property but exclusive of salaries of statutory employees—of about $32.68 per thousand. This compares favorably with the production cost per thousand at the regularly established stations. It should also be taken into consideration that there were several quite unavoidable factors militating against the highest production of fish and tending to increase the cost per thousand. The most serious of these was the flood in May, 1923, when a large number of newly hatched fry were lost, materially reducing the productivity of all the ponds. It seems certain that the cost per thousand fish can be materially lowered next year.

WHITE SULPHUR SPRINGS (W. VA.) STATION

[EDW. M. HAYNES, Superintendent]

The results of the trout propagation work at this station were generally successful, the year's output of fingerling trout being the largest in its history. Three species were handled—brook trout, the product of eggs purchased from commercial fish culturists, rainbow trout derived from eggs taken from brood fish produced in the station ponds, and Loch Leven trout resulting from eggs shipped from the Meadow Creek (Mont.) field station. It would appear from past experience that a brood stock of brook trout can not be successfully maintained at this station, while rainbow trout, on the other hand, have always been reared without difficulty in ponds of almost any description, and the fish appear to be uniformly healthy. In addition to the brook-trout eggs purchased by the bureau, 750,000 commercial eggs of this species, the property of the State of West Virginia, were incubated. The entire stock was developed with a loss of less than 4 per cent, and during the spring the fry belonging to the State were called for and distributed by State employees. The Loch Leven trout eggs were received in good condition and produced healthy, active fry. While the fingerlings are of somewhat slower growth than those of the rainbow or brook trout the losses appear to be lighter, and it is believed this species will prove well suited to many waters of West Virginia that are not now productive of either the rainbow or the brook trout and are too cold for bass.

Some of the eggs received from commercial hatcheries were packed by the bulk method and the remainder were shipped on trays. After years of experience with both methods the conclusion has been reached that tray shipments produce the best results. When shipped by the bulk method, there is apt to be considerable indentation and loss, especially if the eggs are somewhat overdeveloped.

This station has never attained any marked degree of success in propagating the small-mouth black bass, as their nesting is always interfered with by unseasonable weather during the spring. The past season was no exception, and in addition to unfavorable climatic conditions the work was handicapped by an inadequate brood stock.

During the year the small obsolete rearing ponds Nos. 7, 8, and 9 were converted into one large cement pond, and the remaining ponds of the series—4, 5, and 6—were filled in, graded, and sown to grass, greatly improving the appearance of the reservation. Minor improvements were made to a number of the other ponds, and an asbestos shingle roof of the diagonal type style was placed on the superintendent's cottage. It is believed these shingles will give better service than cedar shingles.

WYTHEVILLE (VA.) STATION

[C. B. GRATER, Superintendent]

During the year the water supply to the bass ponds was changed by placing the inlet about 50 feet from the outlet. After heavy rains the flow into these ponds is always roily, and with the inlet located as formerly, at the upper end of the system, the sediment is carried throughout its length and deposited over the entire pond area. Roily water during the nesting season of the bass is very injurious, as the majority of the eggs with which it comes in contact are usually smothered. Under the new arrangement the deposits are confined to a limited area around the outlet, and the outcome of the past season's work showed a marked increase over recent years in the production of pondfishes.

The soft mud deposited in several of the ponds had enabled the growth of water lilies to become firmly established, and the smaller plant forms, which serve as nurseries for the development of natural food for young fish, were in danger of being choked out. In advance of the spawning season the mud deposits were removed, and the result was a noticeable decline in the growth of lilies.

The rainbow-trout spawning season extended from October 15 to March 7, during which period 944,000 eggs were collected. In advance of the spawning period the brood trout were segregated into five lots, according to age, with the view of keeping an accurate record of the eggs from each lot, such information being desirable in the selection of eyed eggs for shipment.

Lot 1 comprised part of the fish over 5 years old; lot 2, 5 years; lot 3, the remainder of the fish over 5 years; lot 4, 3 years; lot 5, 2 years. Lot 1 yielded 498,600 green eggs, or 51 per cent of the total collection. With a few exceptions, however, they were of very poor quality, particularly in the early stages. The loss amounted to 38.5 per cent. Lot 2 produced 112,400 eggs, on which there was a loss of 38.8 per cent. Lot 3 produced 48,950 eggs, and the loss amounted to 35.5. From lot 4, 175,500 eggs were secured, on which a loss of 32.2 was sustained. Lot 5 yielded 20,150 eggs, and the loss was 45.9. As was expected, lot 5 produced the general average of good eggs that is usually obtained in collections from fish 2 years old, but the fry losses were heavier than had been anticipated.

The experiment undertaken last year of mixing a small amount of iodine with the food given to a lot of adult fish badly affected with thyroid tumor was continued to the close of the season, and there was a very noticeable reduction in the extent of the disease.

PONDFISH-CULTURAL STATIONS

The group comprises seven main stations and two substations. As a whole the results of the work were fairly satisfactory, though unfavorable weather during the spawning season and inability to obtain an adequate supply of suitable brood fishes served to curtail the output at some points. The following table gives the aggregate output of these stations by species during the fiscal years 1923 and 1924:

	1923	1924
Large-mouth black bass	1,478,204	1,526,355
Small-mouth black bass	422,200	578,385
Sunfish	260,888	292,525
Crappie	6,980	40,841
Catfish	13,505	10,745
Rock bass	19,610	21,425
Warmouth bass	8,900	3,945

COLD SPRINGS (GA.) STATION AND SUBSTATION

[CHAS. A. BULLOCK, Superintendent]

The work at this station was handicapped owing to the impossibility of securing an adequate stock of brood fish of the large-mouth black bass. The transfer of adult fish to this station from more northerly sections has not met with good results, and they appear to be very scarce in local waters. Another unfavorable factor was the unseasonably late spring and consequent low water temperatures. The first bass nests were observed on March 23, whereas in previous years spawning has commenced as early as March 8. It would appear that the late spring was conducive to the growth of such natural food as animal plankton, mostly daphnids, as these were produced in larger numbers than heretofore. Carnivorous insects and beetles were very scarce.

Past experience seems to demonstrate that crappie can not be successfully handled in the ponds at this station. The results obtained after a number of years' work along this line have been almost negative. A noteworthy fact in connection with these efforts is that the brood fish are always more or less emaciated when removed from the ponds in the fall.

Harris Ponds (*Ga.*) *substation.*—The output of sunfish from this field station has continued to increase from year to year. During the past season it reached a total of 95,600 fingerlings. Sixty adult catfish placed in three of the ponds produced only 5,300 fingerlings. This indicates a considerable falling off in output as compared with the average, and it can only be accounted for by the unusual water conditions.

EDENTON (N. C.) STATION

[WM. S. VINCENT, Superintendent]

For certain reasons not satisfactorily explained the propagation of the so-called pondfishes has never been attended with any high degree of success at the Edenton station. Fish-cultural work along this line during the fiscal year 1924 involved the large-mouth black bass, the bluegill sunfish (bream), the crappie, and the catfish. The work was moderately successful as compared with the results of past years. Some improvements were undertaken during the year with the view of increasing the extent of the work in this line of endeavor, among them being an increase in the water area of certain ponds, eradication of undesirable vegetation, and the introduction of new brood stock.

LOUISVILLE (KY.) STATION

[C. W. BURNHAM, Superintendent]

Owing to the impossibility of securing an adequate stock of brood large-mouth black bass the output of this station was curtailed as compared with the average of recent years. For the work of this station brood bass are obtained in the spring months, much better results being thus attained than by collecting the fish in the fall. Probably the explanation is that the fish are apt to be more evenly mated in the spring.

Five hundred adult small-mouth bass were distributed in four breeding ponds, each of which is three-quarters of an acre in area, and 522,000 fry and 8,285 fingerlings were produced. For the past two years it has been the practice at this station to handle the fry when first hatched, placing them in the ordinary shipping cans on removal from the ponds. This method has been more successful than past attempts to hold the fry in tanks or troughs. The usual iron frame retainers were placed around the schools of fry before they scattered from the nests.

MAMMOTH SPRING (ARK.) STATION

[DELL BROWN, Superintendent]

Though this station is primarily adapted to the culture of small-mouth black bass, great difficulty is experienced in securing from local waters sufficient adults to fill brood stock requirements, and most of the bass transferred here from northern waters refuse artificial food. The season's work with this species was greatly interfered with and the output curtailed by unseasonably cold inclement weather. The first spawning occurred in early April, and from the 81 nests of eggs deposited in the course of that month there was an output of approximately 48,000 No. 1 fingerling fish.

In view of the existing shortage in the number of brood large-mouth bass, the year's production of fingerling fish of that species was much larger than might have been expected. These fish spawned from April 4 to the end of June. The large-mouth bass at this station do not appear to take to the artificial nests as readily as do the small-mouth bass, but when they do occupy them the results in fry are much larger. Before the young fish leave the nests cheesecloth retainers are placed around the schools, and they are transferred to the ponds used earlier in the season for the rearing of small-mouth bass.

ORANGEBURG (S. C.) STATION

[G. W. N. BROWN, Superintendent]

Owing to the unusually severe weather prevailing in late February and early March the spawning of the large-mouth black bass began fully 15 days later than ever before at this station. The first eggs were discovered on March 5, and the fish continued to spawn at intervals until about the middle of June. A large majority of the first eggs deposited were killed by sudden temperature changes, and the subsequent loss of fry was very heavy, the unusually roily water making it difficult to locate the schools of young fish.

In addition to the work with the black bass, limited numbers of warmouth bass and bluegill sunfish (bream) were produced. Public sentiment appears to favor the introduction of the latter species in most of the waters of the State, and with the view of increasing the output it is quite probable that some of the ponds now devoted to bass culture will hereafter be stocked with sunfish.

SAN MARCOS (TEX.) STATION

[MARK RILEY, Superintendent]

Though the work at this station involved six species of fish, as is shown in the general distribution statement on page 434, most of the facilities were concentrated on the propagation of the large-mouth blackbass, for which there is a wide and steadily increasing demand in State of Texas. The total output was somewhat below that of the preceding year, though it was well above the average of recent years, and as regards the size and quality of the fish distributed the results were very satisfactory.

This station has recently been engaged in fish-cultural work in conjunction with certain municipalities in Texas. The ponds constructed by the citizens of New Braunfels are now in very good condition and are well stocked with bass. Four ponds constructed by the local public at Medina Lake were completed too late to be of much service in the production of bass during the fiscal year. However, one of them was stocked with crappie, and a few bass were produced in another. Two ponds, constructed by the citizens of Kerrville, were stocked with brood bass in advance of the spawning season, but high water during the spring washed out the end of one of them, permitting the fish to escape. All of these ponds are under the jurisdiction of the San Marcos station and are regularly inspected by a member of the station personnel.

A consignment of rainbow-trout eggs transferred to Medina Lake from the Saratoga (Wyo.) station during the spring was incubated successfully, and the resulting fry were planted in the deeper waters of the lake where conditions appear favorable to the species. In December, 1922, approximately 7,000 rainbow trout 4 inches in length were planted in this lake. Several of these fish were caught during the past spring, the largest of them measuring 17½ inches in length. The waters of Texas are not generally adapted to the rainbow trout, but on account of the depth in Medina Lake and the fact that it is partially fed by springs it is believed that certain parts of it may be successfully stocked with that species. In view of existing conditions it is probable that bass and trout will live in the lake in harmony.

TUPELO (MISS.) STATION

[C. R. Wiant, Superintendent]

In advance of the spawning season of the large-mouth black bass, which extended from April 9 to June 3, the 460 brood fish of this species were distributed among three ponds of an aggregate area of 4.16 acres. The fish ranged in weight from 1½ to 5 pounds, and the three ponds yielded for distribution 461,500 fry and 53,230 fingerling fish varying in size from No. 1 to No. 4. The distribution of this species was commenced on April 28 and continued to June 25. A very satisfactory season's work was accomplished with the sunfish, but the results of the operations with the crappie were rather poor, probably because of unsuitable pond conditions.

LAKELAND (MD.) PONDS SUBSTATION

[Supervised by Washington office of fish culture]

This pond system is approximately 75 acres in area, and its water supply is obtained from an adjoining creek. It is situated about 8 miles from the city of Washington on the Baltimore & Ohio Railroad, this road and the interurban electric line of the Washington Railway & Electric Co. passing through the land.

With the view of utilizing these ponds for fish-cultural work, the Bureau of Fisheries secured a 3-year lease of them in the early spring of 1923. The five ponds available for immediate use, covering an area of approximately 25 acres, were at once stocked with limited numbers of black bass, crappie, and a few catfish. As a result of this stocking the ponds yielded 29,085 large-mouth black bass ranging from 2 to 6 inches in length, 34,235 fingerling crappie, and about 2,000 fingerling catfish during October, 1923. An interesting feature of the work was that this entire stock of young crappie resulted from the spawning of 8 adult fish of that species.

During the spring of 1924 the ponds were stocked with large-mouth black bass obtained from the Potomac River, and also with brood crappie transferred from the Edenton (N. C.) station.

CENTRAL STATION AND AQUARIUM, WASHINGTON, D. C.

[L. G. Harron, Superintendent]

The central station aquarium at Washington, D. C., was operated as heretofore. A total of 35 species of fish and marine animals comprised the year's exhibit, most of these being carried through the summer months. Trout of various species were acquired as soon as the water became cool enough to hold them successfully, and with the rising of the temperature in early spring they were distributed to applicants or liberated in suitable public waters of the region. During the winter attempts were made to incubate eggs of the chinook salmon, whitefish, and cisco in the exhibit hatchery, but the work in every instance resulted in failure, the eggs being killed by the chlorine with which the city water supply is charged by the health authorities.

In addition to its usual activities the central station was used during the year as a holding and distributing point for the output of the Lakeland (Md.) ponds. In connection with this work 88,399 fishes were handled, practically all of them being large-mouth black bass, crappie, and bluegill sunfish.

Part 2.—DISTRIBUTION OF FISH AND FISH EGGS

[E. C. Fearnow, Superintendent of Fish Distribution]

During the fiscal year ended June 30, 1924, distribution of the bureau's output of fry and fingerling fish was made to approximately 10,000 individual applicants and 2,000 organizations. Ten per cent of the total output is diverted to inland waters for the purpose of maintaining a supply of fresh-water fishes in streams and lakes. The importance of this phase of the bureau's work is being recognized by a number of railroad companies, which grant free or reduced transportation for the bureau's cars when handling shipments of live fish for waters contiguous to their lines, and by organizations and individuals who cooperate with the bureau to the extent of meeting consignments at railroad stations and planting the fish in suitable waters at their own expense.

The species available for stocking interior waters are black-spotted, brook, and rainbow trouts, catfish, large-mouth black bass, small-mouth black bass, rock bass, crappie, and bream. The bureau usually is able to furnish reasonable allotments of trout, as the eggs of this species can be hatched artificially, but great difficulty is experienced in obtaining a sufficient number of large-mouth and small-mouth black bass to meet requirements, and at the present time the bureau is unable to make prompt deliveries of these species, especially of the small-mouth variety, which is propagated at only a few of its hatcheries.

During the fiscal year 1924 an unusually large number of applications were filled, but the output of fish, while larger than that of the previous year, was not sufficient to meet the increased demand.

Following are comparative figures showing the number of miles traveled by cars and messengers, number of applications honored, total output of fish, and the cost of distribution for the fiscal years 1923 and 1924:

Fiscal year	Total output of fish	Number of miles traveled		Number of applications honored	Cost of distribution	Cost of distribution per 1,000 fish
		Cars	Messengers			
1923	4, 314, 859, 029	80, 118	345, 387	10, 939	$58, 751. 71	$0. 013
1924	5, 361, 810, 654	76, 221	342, 677	12, 000	58, 783. 01	. 011

Summary, by species, of distribution of fish to all applicants, United States and Territories, fiscal year 1924

State and species	Number
Alabama:	
Catfish	6, 115
Rainbow trout	400
Loch Leven trout	5, 400
Crappie	3, 010
Large-mouth black bass	168, 016
Rock bass	1, 600
Sunfish	66. 500
Alaska: Sockeye salmon	25, 916, 845
Arizona:	
Catfish	1, 900
Rainbow trout	4, 000
Black-spotted trout	40, 000
Brook trout	54, 000
Crappie	300
Large-mouth black bass	2, 100
Sunfish	1, 000
Arkansas:	
Rainbow trout	81, 060
Crappie	400
Large-mouth black bass	65. 625
Small-mouth black bass	20, 000
Rock bass	19, 250
Sunfish	4, 375
California:	
Catfish	100
Chinook salmon	5, 536, 000
Colorado:	
Catfish	9, 710
Steelhead salmon	28, 500
Rainbow trout	7, 000
Black-spotted trout	771, 800
Loch Leven trout	311, 000
Lake trout	67, 500
Brook trout	3, 132, 780
Large-mouth black bass	12, 715
Sunfish	2, 515
Yellow perch	1, 450
Connecticut:	
Carp	600
Brook trout	27. 000
Pike perch	630, 000
Yellow perch	100
Delaware:	
Crappie	3, 525
Large-mouth black bass	6, 070
Sunfish	5, 000
District of Columbia:	
Rainbow trout	5, 050
Brook trout	4, 500
Crappie	50
Sunfish	10
Georgia:	
Catfish	3, 575
Steelhead salmon	5, 000
Rainbow trout	29, 000
Brook trout	42, 000
Crappie	600
Large-mouth black bass	121, 975
Rock bass	1, 200
Warmouth bass	2, 000
Sunfish	57, 625
Idaho:	
Catfish	104
Chinook salmon	448, 000
Rainbow trout	51, 080
Black-spotted trout	25, 000
Brook trout	8, 840
Illinois:	
Catfish	101, 700
Buffalo fish	43, 600
Carp	20, 100
Crappie	30, 794
Large-mouth black bass	14, 959
Sunfish	37, 570
Yellow perch	1, 511
White bass	108
Indiana:	
Catfish	10, 100
Rainbow trout	4, 500
Brook trout	69, 000
Crappie	2, 225
Large-mouth black bass	14, 855
Small-mouth black bass	204, 605
Rock bass	900
Sunfish	19, 625
Pike perch	1, 000, 000
Yellow perch	3, 950
Iowa:	
Catfish	121, 774
Buffalo fish	46, 729
Carp	50, 584
Rainbow trout	14, 496
Brook trout	4, 900

Summary, by species, of distribution of fish to all applicants, United States and Territories, fiscal year 1924—Continued

State and species	Number	State and species	Number
Iowa—Continued.		Minnesota—Continued.	
Crappie	78, 190	Crappie	17, 800
Large-mouth black bass	33, 119	Large-mouth black bass	18, 270
Small-mouth black bass	2, 150	Sunfish	48, 750
Warmouth bass	21	Pike perch	150, 000
Sunfish	102, 696	Yellow perch	100
Kansas:		Mississippi:	
Large-mouth black bass	2, 525	Catfish	37, 470
Sunfish	8, 445	Crappie	20, 135
Yellow perch	125	Large-mouth black bass	413, 485
Kentucky:		Rock bass	11, 075
Catfish	6, 200	Warmouth bass	538
Carp	50	Sunfish	750, 525
Crappie	6, 700	Missouri:	
Large-mouth black bass	3, 825	Catfish	2, 000
Small-mouth black bass	300, 185	Rainbow trout	208, 347
Rock bass	2, 000	Brook trout	12, 915
Sunfish	15, 875	Crappie	2, 686
Yellow perch	480	Large-mouth black bass	18, 853
Louisiana:		Small-mouth black bass	22, 815
Catfish	2, 250	Rock bass	5, 800
Buffalo fish	182, 462, 500	Sunfish	119, 643
Crappie	400	Yellow perch	1, 576, 245
Large-mouth black bass	5, 625	Montana:	
Rock bass	150	Catfish	3, 310
Sunfish	5, 230	Steelhead salmon	26, 000
Maine:		Rainbow trout	1, 443, 422
Humpback salmon	353, 580	Black-spotted trout	1, 811, 860
Atlantic salmon	501, 000	Loch Leven trout	421, 000
Landlocked salmon	862, 290	Lake trout	61, 000
Rainbow trout	9, 120	Brook trout	698, 855
Lake trout	9, 296	Crappie	1, 125
Brook trout	1, 078, 150	Large-mouth black bass	1, 125
Smelt	9, 300, 000	Sunfish	400
Crappie	110	Nebraska:	
Large-mouth black bass	1, 700	Catfish	300
Small-mouth black bass	1, 000	Loch Leven trout	149, 000
Flounder	1, 548, 771, 000	Brook trout	32, 000
Maryland:		Crappie	280
Catfish	2, 045	Large-mouth black bass	1, 125
Carp	6	Yellow perch	66
Shad	3, 094, 000	New Hampshire:	
Chinook salmon	3, 200	Catfish	2, 400
Rainbow trout	10, 234	Steelhead salmon	5, 000
Loch Leven trout	6, 800	Landlocked salmon	30, 420
Brook trout	58, 000	Rainbow trout	29, 000
Crappie	2, 225	Lake trout	33, 500
Large-mouth black bass	12, 225	Brook trout	554, 221
Sunfish	7, 900	Crappie	400
Yellow perch	105, 692, 400	Large-mouth black bass	720
Massachusetts:		Small-mouth black bass	900
Catfish	6, 300	Pike perch	1, 750, 000
Rainbow trout	9, 270	New Jersey:	
Brook trout	78, 890	Brook trout	2, 400
Large-mouth black bass	4, 585	Crappie	1, 170
Sunfish	4, 700	Large-mouth black bass	5, 780
Pike perch	776, 000	New Mexico:	
Cod	392, 423, 000	Catfish	1, 200
Haddock	2, 590, 000	Black-spotted trout	18, 000
Pollock	263, 440, 000	Brook trout	117, 000
Flounder	607, 362, 000	Crappie	1, 800
Yellow perch	255	Large-mouth black bass	2, 275
Michigan:		Rock bass	325
Whitefish	69, 050, 000	Sunfish	2, 400
Steelhead salmon	11, 000	New York:	
Rainbow trout	102, 855	Catfish	5, 400
Lake trout	27, 513, 500	Whitefish	72, 670, 000
Brook trout	535, 580	Cisco	128, 360, 000
Crappie	1, 175	Steelhead salmon	5, 000
Large-mouth black bass	24, 865	Landlocked salmon	3, 000
Small-mouth black bass	48, 055	Rainbow trout	92, 000
Sunfish	12, 500	Lake trout	757, 000
Pike perch	300, 000	Brook trout	915, 000
Yellow perch	400	Crappie	6, 060
Minnesota:		Large-mouth black bass	6, 785
Catfish	10, 100	Sunfish	1, 600
Whitefish	6, 600, 000	Pike perch	11, 360, 000
Steelhead salmon	30, 000	Yellow perch	800, 225
Rainbow trout	45, 400	North Carolina:	
Lake trout	3, 206, 346	Catfish	200
Brook trout	130, 800	Shad	7, 070, 000

Summary, by species, of distribution os fish to all applicants, United States and Territories, fiscal year 1924—Continued

State and species	Number
North Carolina—Continued.	
Glut herring	95,000,000
Steelhead salmon	5,000
Rainbow trout	243,900
Loch Leven trout	21,000
Brook trout	249,950
Crappie	180
Large-mouth black bass	103,670
Rock bass	7,500
Sunfish	24,230
Yellow perch	1,950,000
North Dakota:	
Catfish	2,450
Crappie	480
Large-mouth black bass	2,035
Sunfish	2,000
Yellow perch	800
Ohio:	
Catfish	5,800
Carp	28,875,000
Whitefish	148,400,000
Rainbow trout	2,900
Brook trout	41,200
Pike and pickerel	7,392,000
Crappie	528
Large-mouth black bass	19,815
Small-mouth black bass	49,590
Rock bass	1,500
Sunfish	13,660
Pike perch	35,000,000
Yellow perch	3,917,245
Oklahoma:	
Rainbow trout	10,300
Crappie	14,521
Large-mouth black bass	27,700
Rock bass	1,900
Sunfish	8,835
Oregon:	
Chinook salmon	15,740,500
Chum salmon	7,600
Silver salmon	7,538,150
Sockeye salmon	23,700
Steelhead salmon	2,286,500
Rainbow trout	208,600
Black-spotted trout	18,000
Brook trout	360,000
Pennsylvania:	
Catfish	15,350
Rainbow trout	255,200
Loch Leven trout	39,000
Brook trout	379,000
Crappie	10,850
Large-mouth black bass	19,485
Sunfish	37,425
Pike perch	340,000
Yellow perch	2,050
Rhode Island:	
Brook trout	5,000
Pike perch	560,000
Flounder	88,157,000
South Carolina:	
Rainbow trout	23,800
Brook trout	15,000
Large-mouth black bass	186,786
Warmouth bass	1,525
Sunfish	2,350
South Dakota:	
Catfish	900
Steelhead salmon	44,600
Rainbow trout	14,000
Loch Leven trout	695,500
Brook trout	315,600
Crappie	900
Large-mouth black bass	1,000
Sunfish	880
Tennessee:	
Catfish	7,900
Rainbow trout	66,000
Loch Leven trout	10.100
Brook trout	27,900
Large-mouth black bass	28,350
Tennessee—Continued.	
Small-mouth black bass	600
Rock bass	13,350
Sunfish	9,525
Texas:	
Catfish	3,300
Crappie	4,452
Large-mouth black bass	491,357
Rock bass	325
Warmouth bass	420
Sunfish	9,949
Utah:	
Rainbow trout	332,575
Black-spotted trout	25,000
Brook trout	224,900
Vermont:	
Steelhead salmon	5,000
Landlocked salmon	12,000
Rainbow trout	4.000
Lake trout	136,010
Brook trout	528,190
Large-mouth black bass	450
Small-mouth black bass	1,900
Pike perch	11,184,000
Yellow perch	1,000,000
Virginia:	
Catfish	3,250
Shad	4,869,000
Rainbow trout	99,400
Loch Leven trout	4,000
Brook trout	78,750
Crappie	14,220
Large-mouth black bass	208,360
Small-mouth black bass	14,000
Rock bass	20,800
Sunfish	38,830
Yellow perch	88,577,040
Washington:	
Chinook salmon	21,593,705
Chum salmon	24,270,320
Humpback salmon	918,000
Silver salmon	14,317.000
Sockeye salmon	13,047,840
Steelhead salmon	2,004,560
Rainbow trout	4,000
Brook trout	200,000
West Virginia:	
Catfish	2,250
Carp	75
Rainbow trout	59,084
Loch Leven trout	5,000
Brook trout	45,250
Crappie	1,425
Large-mouth black bass	36,390
Rock bass	4,675
Sunfish	11,850
Yellow perch	300
Wisconsin:	
Catfish	47,836
Carp	119
Whitefish	2,500,000
Rainbow trout	289,600
Loch Leven trout	75,000
Lake trout	516,500
Brook trout	954,400
Crappie	11,286
Large-mouth black bass	100,790
Warmouth bass	15
Sunfish	88,060
Pike perch	1,000,000
Yellow perch	4,770
Wyoming:	
Catfish	11,100
Rainbow trout	72,000
Black-spotted trout	6,015,240
Loch Leven trout	274,000
Brook trout	672,620
Large-mouth black bass	4,400
Sunfish	1,040
Yellow perch	500

Assignments of fish to State fish commissions, fiscal year 1924

[Asterisk (*) denotes fry; all others fingerlings]

State and species	Number	State and species	Number
Illinois:		North Dakota:	
Brook trout	1,060	Black bass	1,950
Rainbow trout	20	Catfish	6,000
Steelhead salmon	130	Crappie	2,000
Iowa:		Sunfish	9,450
Brook trout	10,250	Yellow perch	900
Rainbow trout	12,900	South Dakota: Brook trout	1,500
Maryland:		Utah: Brook trout	22,000
Black bass	1,740	Vermont: Yellow perch	* 8,500,000
Chinook salmon	* 6,000	Washington:	
Crappie	2,500	Brook trout	*477,930
Yellow perch	110	Rainbow trout	195,000
Minnesota:		Silver salmon	*994,990
Catfish	3,000	Steelhead salmon	*298,685
Crappie	5,000	West Virginia:	
Sunfish	7,950	Brook trout	367,000
Yellow perch	245	Loch Leven trout	75,000
Nebraska:		Rainbow trout	300,000
Brook trout	800	Wisconsin:	
Lock Leven trout	4,000	Black bass	19,055
Steelhead salmon	6,000	Catfish	33,800
New Hampshire:		Crappie	10,265
Brook trout	43,200	Sunfish	77,000
Rainbow trout	6,000	Yellow perch	835
New Mexico: Black bass	200	Total	11,504,465

METHOD OF DISTRIBUTION

The bureau apportions its annual output of trouts, basses, sunfishes, crappies, and catfishes to applicants whose requests are on file at the beginning of the distribution periods, giving special consideration to requests that have been carried over from previous years.

The number of fish that can be furnished for a body of water depends on the output of the bureau's hatcheries, the size of the fish at the time of shipment, and the number of applications the bureau is required to fill. The customary allotment is from 1,000 to 5,000 fry, or from 100 to 300 3-inch fish. The bureau, with its limited facilities, does not undertake to furnish more than brood stocks of fish, with the understanding that they will be protected until they have had an opportunity to reproduce.

Blanks on which formal application for fish may be made can be obtained from the bureau upon request. Only one application is necessary in order to secure an allotment for a body of water, and in order to avoid duplications an applicant requesting blanks should give the name of the lake or stream which it is desired to stock. The application when executed should be returned to this office through a Member of Congress.

Applications are formally acknowledged when received, and the period of distribution is indicated on the acknowledgment. Should the bureau be unable to make shipment during the time specified, the applicant is notified accordingly. Requests for fish are forwarded by the bureau to its representatives in the field, who notify the applicants concerning the exact date of delivery and the number of vessels required to contain the consignment. Fish are delivered to railroad stations without expense to the applicant.

Trout are distributed during May and June in the Eastern and Middle Western States, and in the Rocky Mountain region from July to October. Warm-water fishes, including bass, crappie, and bream, are distributed from May to October. It is the bureau's policy to fill applications in the order of their receipt.

DISTRIBUTION OF FISHES OF INTERIOR WATERS

CAR NO. 3

[E. R. Widmyer, Captain]

At the beginning of the fiscal year of 1924 the car's equipment was altered to accommodate 150 pails, its original capacity having been 108 ordinary 10-gallon cans.

The Fearnow pail is made of aluminum, it weighs less than 45 pounds when filled, and will safely carry as many fish as did the old type of can. The new pail increased the car's carrying capacity 40 per cent, and messenger shipments in baggage cars were increased even more, as a single trip contained as many as 100 pails. Under these conditions a considerable saving of funds was effected, as compared with records of past seasons, a maximum supply of fish having been transported at a minimum cost.

Distribution by car No. 3 was begun from the Mississippi River collecting stations on July 18, 1923. In addition to numerous messenger shipments to points in Wisconsin and Minnesota, the car made trips to Minnesota, Wisconsin, Michigan, Illinois, Indiana, and Pennsylvania, carrying from 138 to 160 pails of fish on each trip.

After the close of the distribution the car was moved to Milwaukee, Wis., and placed in the shops for general repairs, after which the car was returned to La Crosse, Wis., and the distribution of rainbow and brook trouts was taken up from the La Crosse station.

On May 1, 1924, the car left La Crosse for Ashland, Wis., with a load of trout for Minnesota and Wisconsin applicants. After completing this trip the car proceeded to Duluth, Minn., where it took up the distribution of the Great Lakes species, making six car trips, eight boat trips, and a number of messenger shipments. From May 3 to June 18 the car and its messengers handled 13,000,000 whitefish, 10,072,000 lake trout, 1,450,000 pike perch, 136,000 brook trout, and 29,000 steelhead trout from the Duluth (Minn.) station.

The car left Duluth on June 18 for St. Paul, Minn., with fish for applicants in western Minnesota, and after completing the trip was moved to La Crosse, where it was held in readiness to take up the distribution of rescued fishes.

During the fiscal year ended June 30, 1924, car No. 3 traveled 12,034 miles and delivered 25,257,785 fish.

CAR NO. 4

[T. S. Kibbe, Acting Captain]

After receiving a general inspection and the necessary repairs at Wilmington, Del., fisheries car No. 4 proceeded to Northville, Mich., arriving at that point on July 2, 1923. The car's crew took charge of the bass and trout distributions from the Northville (Mich.) hatchery, making messenger shipments to points in Michigan, Ohio, and

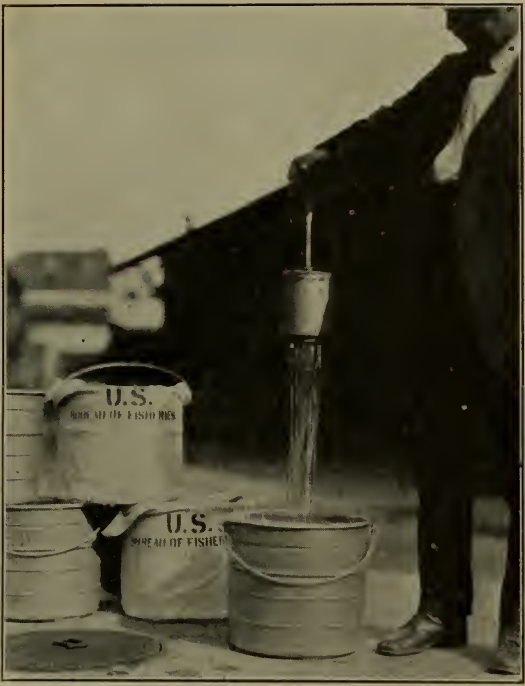

FIG. 1.—Aerating the water in which fish are carried

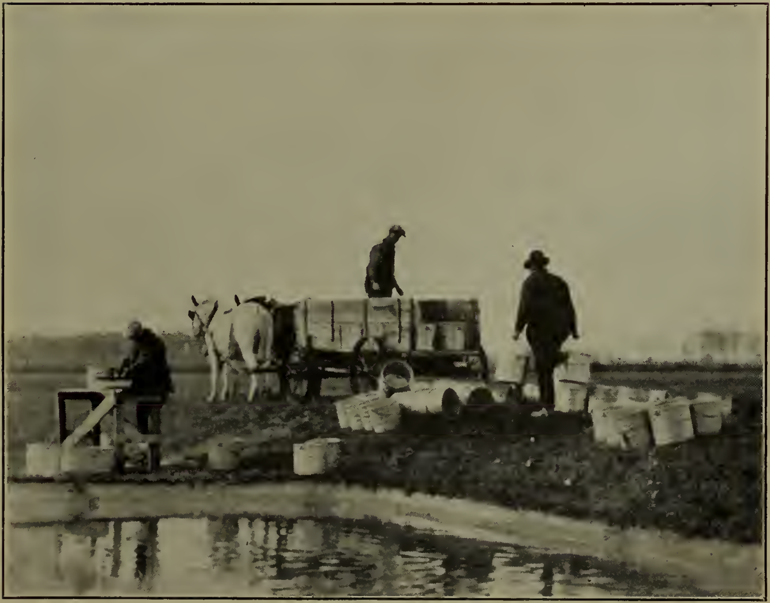

FIG. 2.—Preparing fish for shipment, Langdon, Kans

Indiana, and a carload shipment to Auburn, N. Y., from which point shipments of small-mouth black bass were made by detached messengers to points in Pennsylvania and New Jersey.

The distribution from the Northville (Mich.) station was completed on July 17, and the car then proceeded to La Crosse, Wis., to assist with the distribution of rescued fishes from the upper Mississippi River collecting stations and upon completion of this work returned to Washington, D. C., on September 27.

Early in October the car took up the distribution of bass and crappie from the Lakeland (Md.) ponds. One carload shipment, consisting of 214 pails of bass and crappie, was forwarded to Richmond, Va. The rest of the work was done by messenger shipments from Washington, the car being used to hold the fish until ready for departing trains. The total numbers of fish distributed were 21,260 (3 to 6 inch) large-mouth black bass and 23,425 (2 to 3 inch) crappie. On completion of the Lakeland distribution the crew was detailed to the Washington (D. C.) office of the bureau to assist with the office work.

On February 21, 1924, the car proceeded to the shops at Wilmington, Del., to undergo annual repairs. A train-line air system was installed, making it possible to use train-line air on the fish when in trains or at stations where compressed air is furnished.

On April 28 the car proceeded to White Sulphur Springs, W. Va., to assist in the distribution of trout. Carload shipments were made to Johnstown, Pa.; Richwood, W. Va.; and Philadelphia, Pa. From Philadelphia the car continued to Nashua, N. H., arriving at that point on May 19, where a carload of trout was received for points near Portland, Me. It then proceeded to Bucksport, Me., for the purpose of taking up the distribution from the Craig Brook (Me.) station.

From the Craig Brook station trips were made to Dennysville, Grindstone, Calais, Greenville, Houlton, and Farmington, Me. In the vicinity of these points the following fish were distributed: 494,000 advanced Atlantic-salmon fry, 100,100 1-inch landlocked salmon, and 679,200 1-inch brook trout.

On June 21 the car proceeded to Nashua, N. H., where it received a carload of trout for Wilkes-Barre, Pa., and thence proceeded directly to Washington, D. C., completing the distribution for the fiscal year 1924.

During the fiscal year 1924 car No. 4 traveled 12,099 miles and distributed 205,156 pondfishes, 993,006 trout, 100,100 landlocked salmon, and 494,000 Atlantic salmon.

In previous years it required six teams to load the car at Bucksport, Me., whereas with the Fearnow pails only three loads are necessary, the pails being double-decked. In heavily loaded baggage cars, where space is limited, the pails may be stacked in four or five tiers.

The filtros plugs now used on car No. 4 require very little attention, do not swell when the air is stopped on the fish, and are a decided improvement over the old wooden plugs.

The Bangor & Aroostook and the Maine Central Railroad Cos. made special concessions to fisheries car No. 4 by eliminating the minimum transportation charge and granting the bureau straight 5-fare charges for the movement of the car.

CAR NO. 7

[E. M. LAMON, Captain]

On July 20 the distribution of pondfishes was taken up from the upper Mississippi River stations. During July, August, September, and October, 1923, 214,000 fingerling pondfishes were distributed by the car and its messengers in Michigan, Wisconsin, Indiana, Illinois, Missouri, Arkansas, Tennessee, New York, New Hampshire, Massachusetts, Vermont, Maine, Pennsylvania, Maryland, and Kentucky, supplying 920 applicants.

On December 12 car No. 7 was placed in the Louisville & Nashville Railroad shops and the work of general repairs started. While in the shops the piping was so arranged that compressed air for the fish could be obtained from the train line when the car is moving in a train or parked in a depot where air is available, which eliminates the necessity for using the steam boilers in many instances, thereby effecting a considerable saving in coal. The steel fish compartment covers were eliminated and new wooden covers, hinged in back and center, were installed.

The car left the shops on March 3, and after being fitted up for distribution work proceeded to Fishery, Tenn., to take up the spring distribution from the Erwin (Tenn.) station. The car arrived at Fishery on March 11, and between that date and April 17 there were distributed by the car and its messengers 267,200 brook trout, 437,600 rainbow trout, and 16,600 Loch Leven trout, all fingerlings, to applicants in Tennessee, North Carolina, South Carolina, Georgia, and Alabama.

Car No. 7 arrived at Wytheville, Va., on April 20, where it obtained a shipment of trout for waters in western Pennsylvania, and upon completing the Pennsylvania trip it proceeded to Manchester, Iowa. During May and June 547,300 brook trout and 172,200 rainbow trout fingerlings from the Manchester station and 75,000 Loch Leven trout, 75,000 rainbow trout, and 36,000 brook trout from the La Crosse (Wis.) station were distributed to applicants in Minnesota and Wisconsin.

Car No. 7 traveled 17,642 miles, making 22 trips and supplying 1,850 applicants, and distributing a total of 1,920,900 fingerling fishes.

CAR NO. 8

[E. K. BURNHAM, Captain]

During the year car No. 8 was engaged in the distribution of fishes produced at La Crosse, Wis.; Leadville, Colo.; Langdon, Kans.; and Neosho, Mo., in the course of which it traveled a total of 12,905 miles and made deliveries to 556 individual applicants located in 10 different States. The following table shows the numbers of the various species delivered:

	Fingerlings	Yearlings		Fingerlings	Yearlings
Brook trout	1,161,000		Sunfish	45,610	6,490
Rainbow trout	11,000		Yellow perch	828	30
Black-spotted trout	302,000		Catfish	17,350	280
Steelhead salmon	16,000		Rock bass	2,425	
Lake trout	16,000				
Black bass	46,230	1,060	Total	1,642,914	7,860
Crappie	24,471				

The car has a carrying capacity of 134 10-gallon cans, or 220 of the modern fish pails. The crew made all minor repairs to the interior of the car, thereby considerably reducing the cost of maintenance and repairs.

The most notable improvement in operating equipment is the filtros plug, which is made of rock-like material and is used for liberating compressed air in cans containing live fish. Formerly wooden plugs were used for this purpose, but they proved impracticable because they swell and entirely shut off the air when the pressure is properly reduced. The filtros plug does not swell and close under reduced pressure and liberates the air freely when the pressure is increased.

CAR NO. 9

[A. H. KERTH, Captain]

Distribution work for the fiscal year began July 16, 1923, when the car was equipped with 24 of the new Fearnow pails (aluminum), which were received from car No. 8.

The first trip was taken out of La Crosse, Wis., and consisted of miscellaneous species of river fishes, which were distributed en route to Bozeman (Mont.) station to applicants at Harrison, Nebr.; Lusk, Keeline, and Casper, Wyo.; and Billings, Columbus, and Bozeman, Mont.

During August, 1923, while on a trip with trout, which was being made for the Montana State Fish Commission, it was necessary to use some cans that had been painted inside, and as a result a considerable loss of fish occurred.

Upon completion of the distribution from the Bozeman station the car came east and resumed the work of distributing the miscellaneous river fishes, after which it proceeded to Washington, D. C., and assisted in the distribution from the Lakeland (Md.) ponds.

At the close of the Lakeland distribution the car was placed in the shops at Wilmington, Del., for annual repairs and the crew detailed to fish-cultural and clerical duties.

During the month of March, 1924, an electrically driven air pump was installed on the car. The new pump was used in connection with distribution work with highly satisfactory results, and has not only effected a great saving in the amount of fuel consumed but has also added to the general convenience and safety of the crew by eliminating the necessity of carrying a heavy fire to generate steam for power.

During April, while the car was at Washington, D. C., a new type of brake beam was installed, giving more clearance for the generator belt. The old pulley on the axle was replaced with a wider one, which, it is thought, will prevent the loss of generator belts.

The spring distribution out of the White Sulphur Springs (W. Va.) station was taken up on April 16, 1924. In all, six trips were made from this station, which completed the distribution of fish by car No. 9 for the fiscal year 1924.

The car traveled 21,541 miles during the year, delivering 2,728,300 trout and 52,845 miscellaneous river fishes. At the close of the year it was equipped with the new type of transportation pails.

NEW TRANSPORTATION PAILS

In July, 1923, three of the bureau's cars were completely equipped with the new type of transportation pail (described in Bureau of Fisheries Doc. 941, pp. 93–96), and one partially so, while small allotments of pails were sent to a number of the hatcheries that make extensive distributions. While tabulations have not been made showing the saving brought about at each station where the pails were used, the following table, based on the actual cost of distribution from the bureau's rescue stations and compiled from cost slips submitted by car captains and messengers, shows the cost of distribution from the bureau's Mississippi River collecting stations. This distribution covered practically all the Middle Western States and a few States east of the Allegheny Mountains.

Comparative table showing cost of distributing fishes rescued from the upper Mississippi River during the fiscal years 1923 and 1924[1]

Method	Total number of fish	Total cost	Cans delivered	Applications	Average cost per thousand	Mileage	
						Paid	Free
1923							
Station messengers[2]	68,595	$734.08	644	229	$10.70	11,864	
Car messengers[3]	270,047	2,555.77	2,557	1,174	9.723	33,683	1,026
Distribution cars[4]	590,442	13,287.45	4,527	1,795	22.50	37,763	
1924							
Station messengers[2]	95,425	720.73	779	176	7.553	12,354	
Car messengers[3]	342,058	2,255.00	2,987	1,371	6.593	32,489	
Distribution cars[4]	598,720	8,848.63	4,811	1,929	14.77	30,759	

[1] Includes distribution from La Crosse, Wis., Marquette and Bellevue, Iowa, and Homer, Minn. Size of fish ranges from 1 inch to 6 inches.

[2] Cost of making distribution direct from station without a car.

[3] Detached messenger shipments from cars. Cost in addition to distribution by car.

[4] Cost of transporting fish to destination or until delivered to car messenger.

From the foregoing it will be seen that in 1924 there were handled 117,119 more fish (849 more cans) than in 1923, and an actual saving of $4,752.96 was made. Based on 1923 costs per thousand fish, the expense of handling the 1924 collections would have been as follows: Station messengers, $1,021.25; car messengers, $3,325.83; cars, $13,471.20; or a total of $17,818.08. As the actual cost for 1923 was $11,824.36, on this basis the saving to the bureau would have been $5,993.72.

These savings, which have been brought about by furnishing the cars with transportation pails of the new type, have enabled the bureau to greatly extend its distribution work and at the same time keep within the limits of its appropriation.

At the Craig Brook (Me.), Manchester (Iowa), and White Sulphur Springs (W. Va.) stations the pails are hauled from the station to the car in double-deck loads.

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